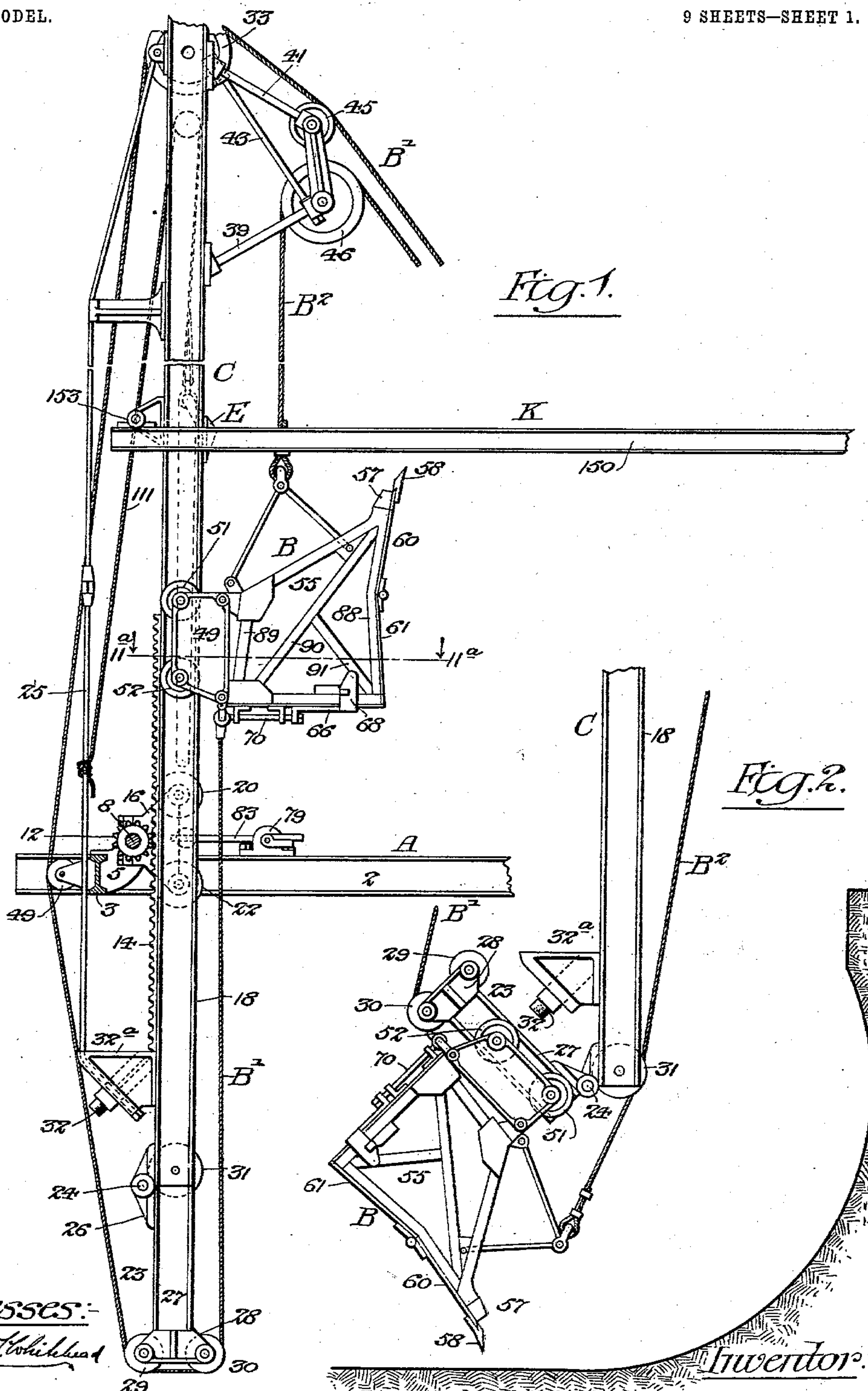


F. M. BISBEE.  
EXCAVATING MACHINE.

APPLICATION FILED JUNE 12, 1903.

NO MODEL.

9 SHEETS—SHEET 1.



Witnesses:

Louis H. Whitehead

Ottis C. Freiburg

Inventor:

Frank M. Bisbee  
by Chas. G. Page atty.

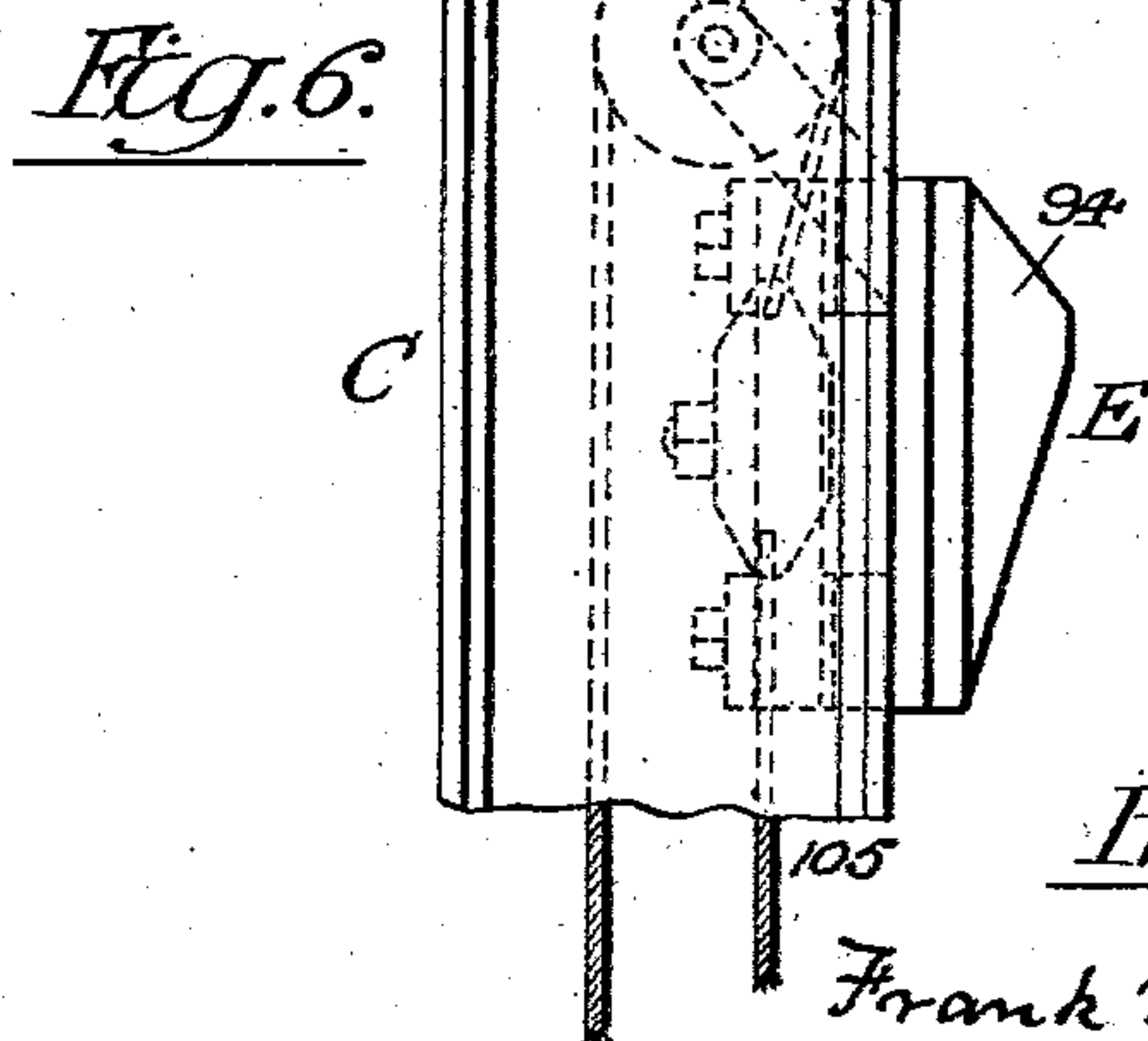
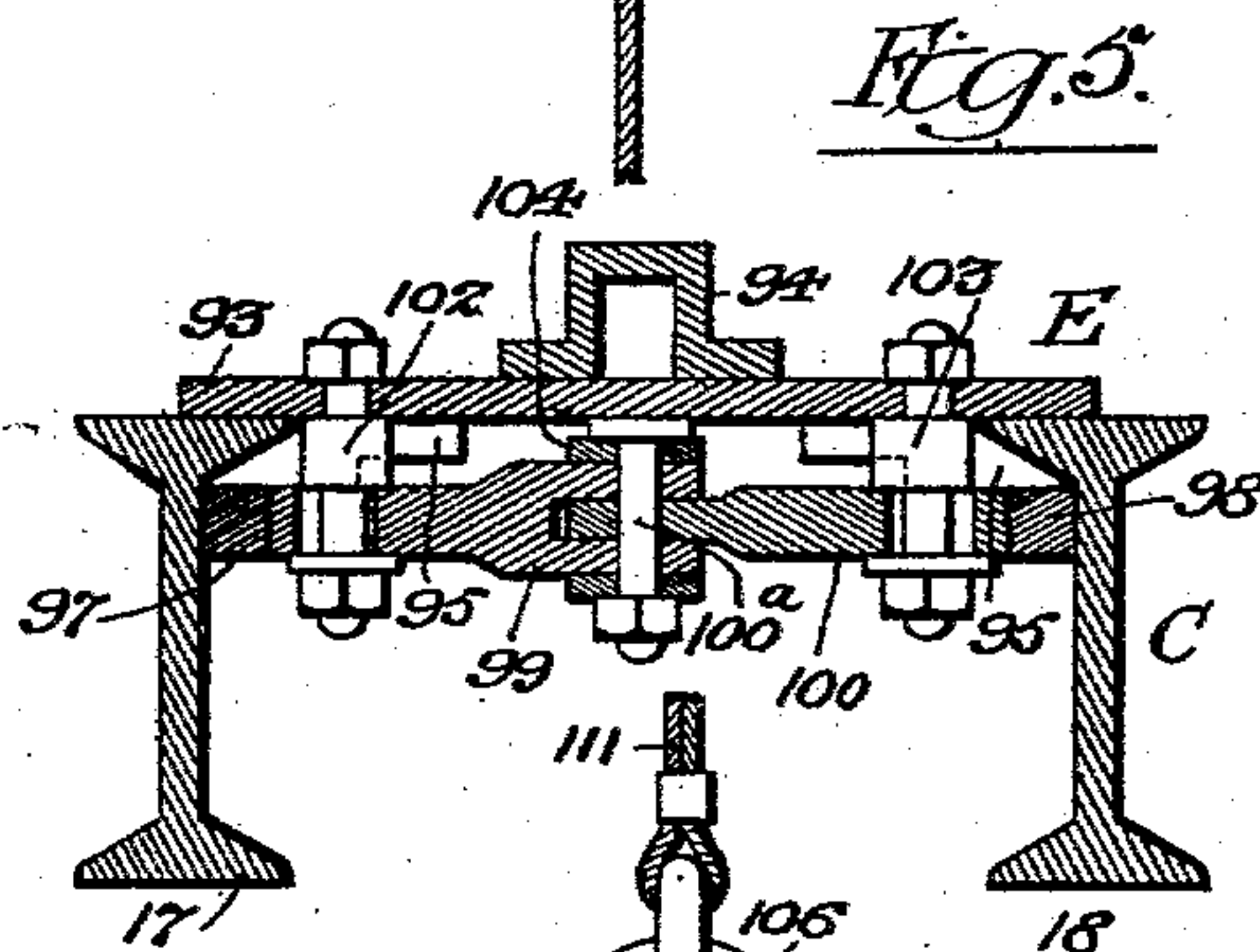
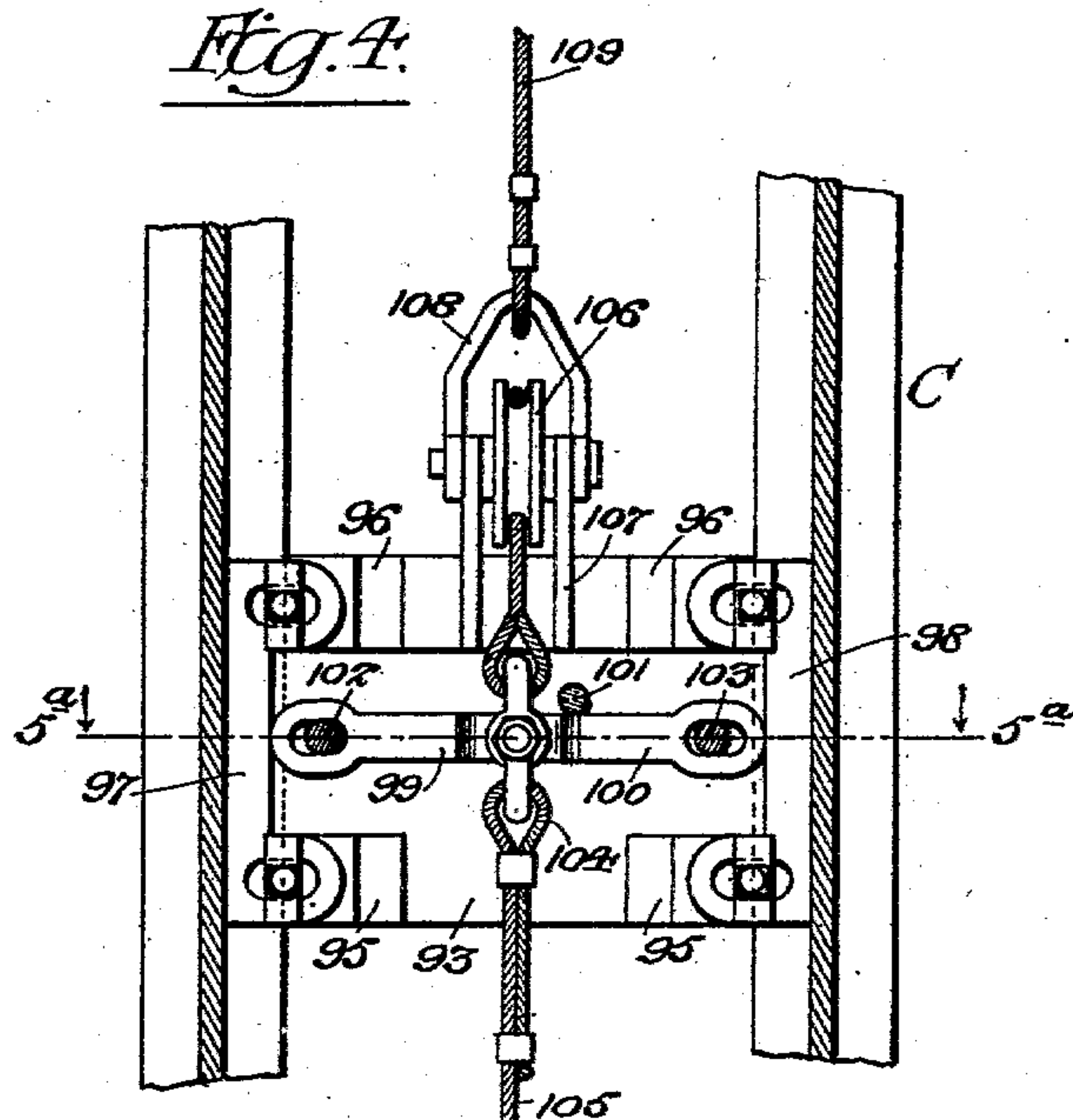
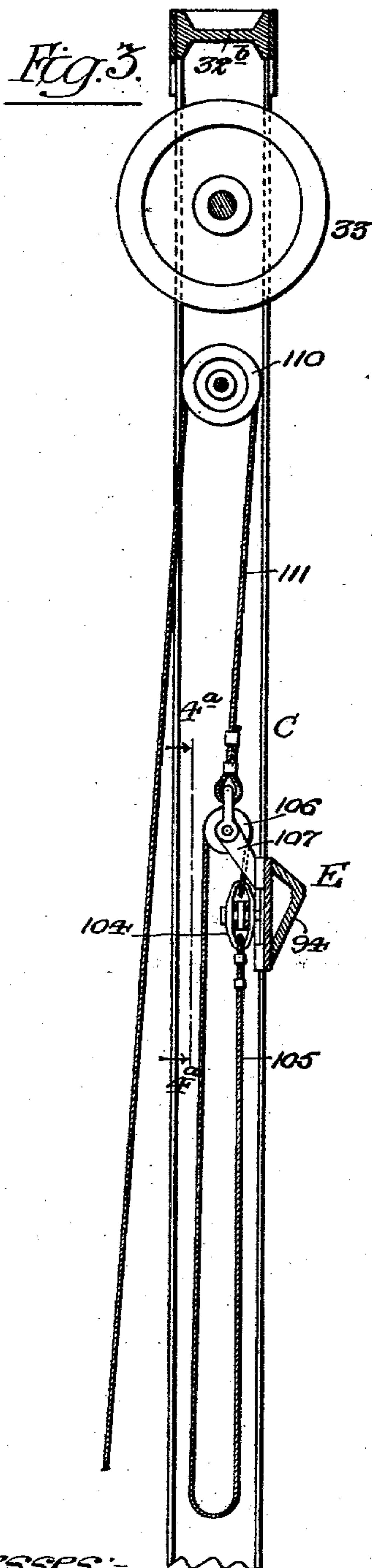
No. 741,099.

PATENTED OCT. 13, 1903.

F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

NO MODEL.

8 SHEETS—SHEET 2.



*Witnesses:-*

*Wm. H. Whitehead*

*Ottillie C. Freiberg*

*Inventor:*

*Frank M. Bisbee*  
*by Chas. G. Page*  
*Att.*



No. 741,099.

PATENTED OCT. 13, 1903.

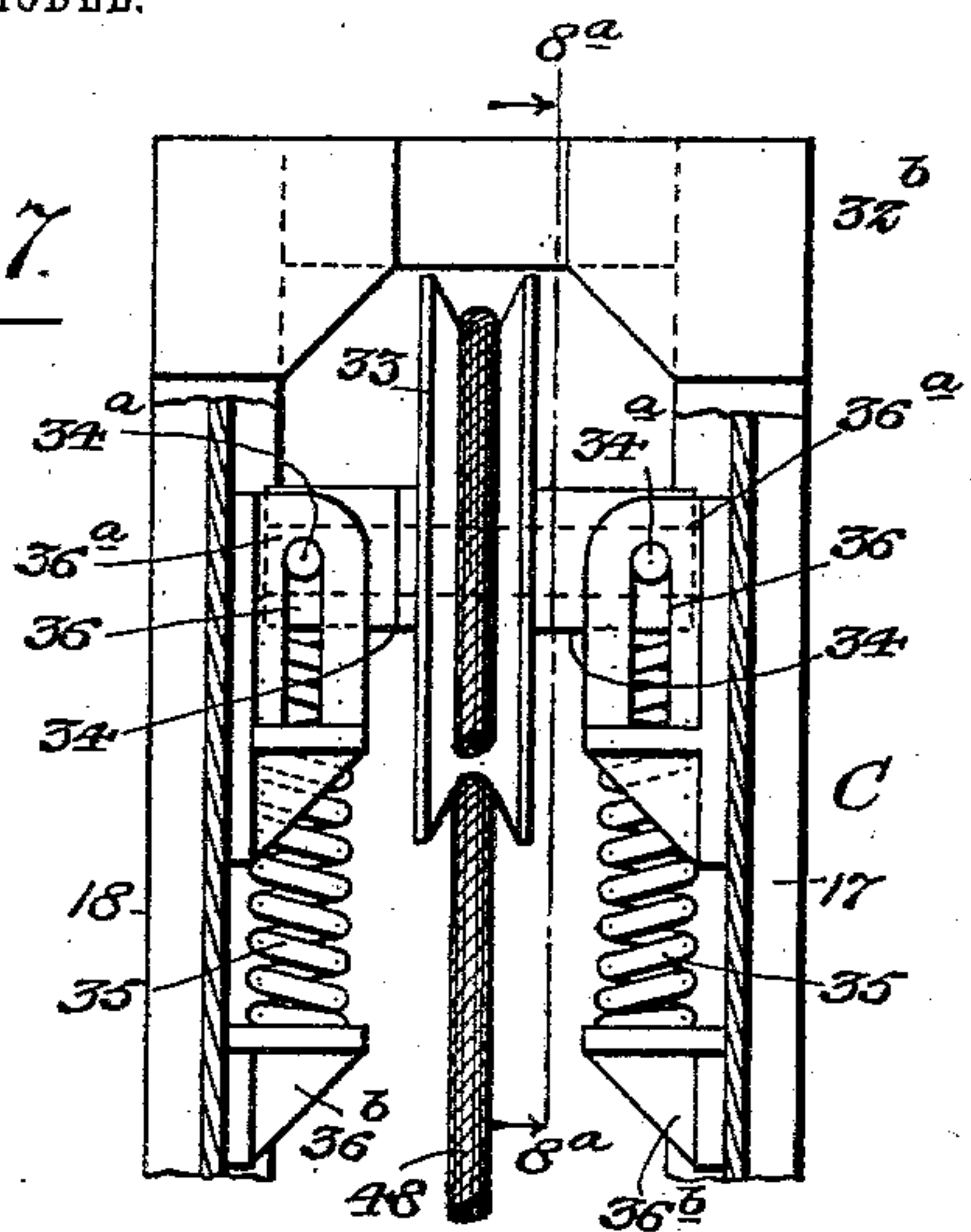
F. M. BISBEE.  
EXCAVATING MACHINE.

APPLICATION FILED JUNE 12, 1903.

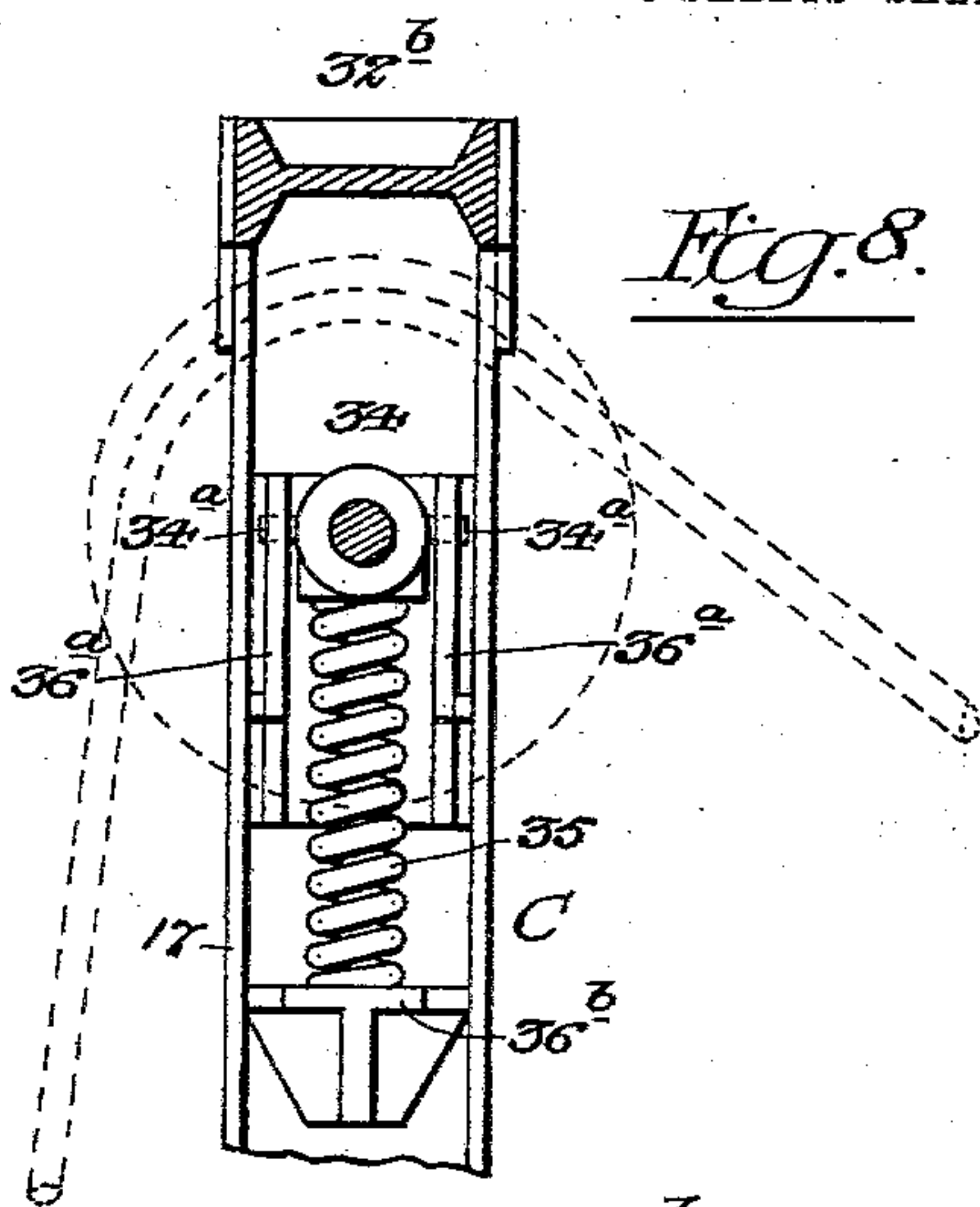
NO MODEL.

9 SHEETS—SHEET 3.

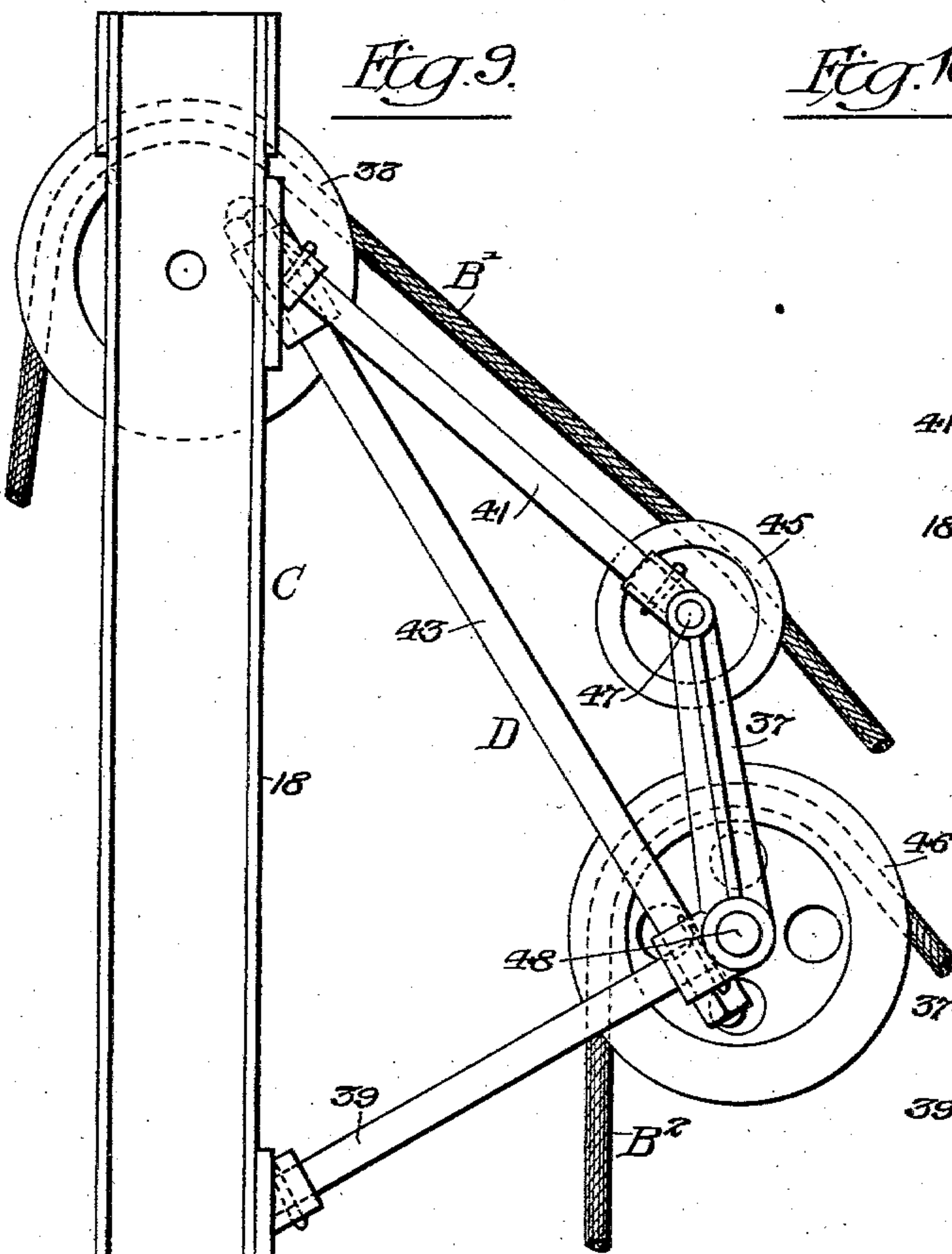
*Fig. 7.*



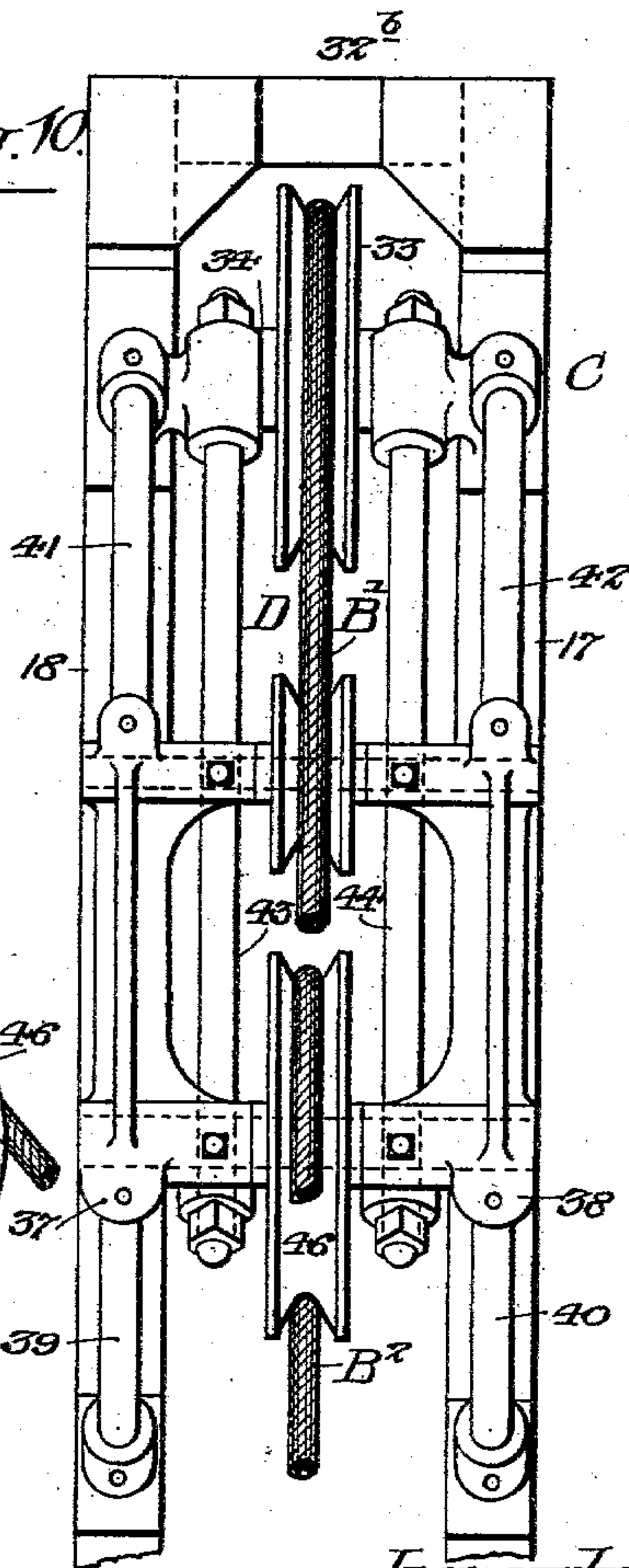
*Fig. 8.*



*Fig. 9.*



*Fig. 10.*



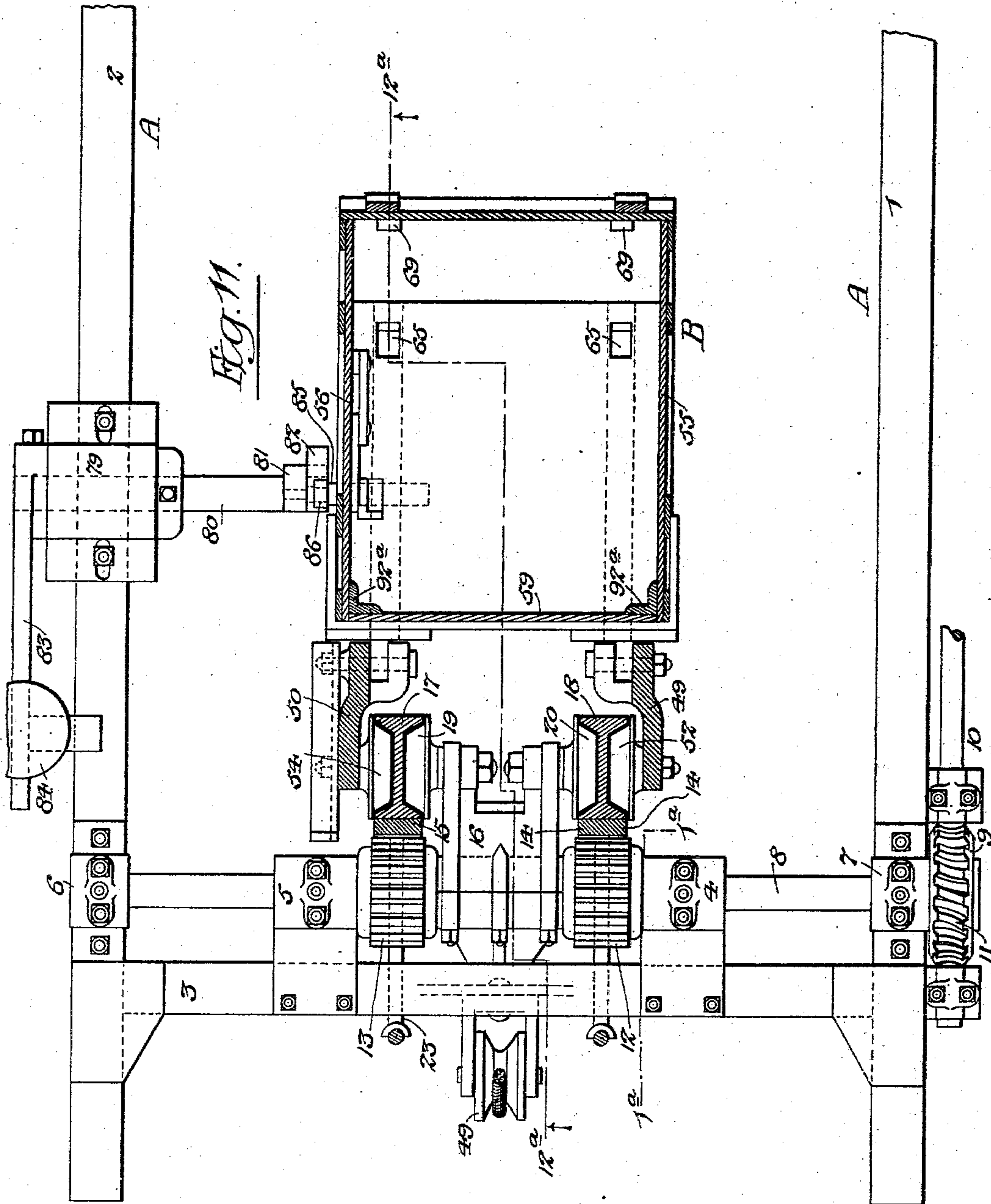
*Witnesses:-*  
*Wm. H. F. Whitelhead*  
*Ottie C. Fairbank*

*Inventor:*  
*Frank M. Bisbee*  
*by Chas. G. Page*  
*att.*

F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

NO MODEL.

9 SHEETS—SHEET 4.



Witnesses:-

Charles M. Whitehead

Ottob C. Freiburg

Inventor:-

Frank M. Bisbee  
by Chas. G. Page  
Atty.



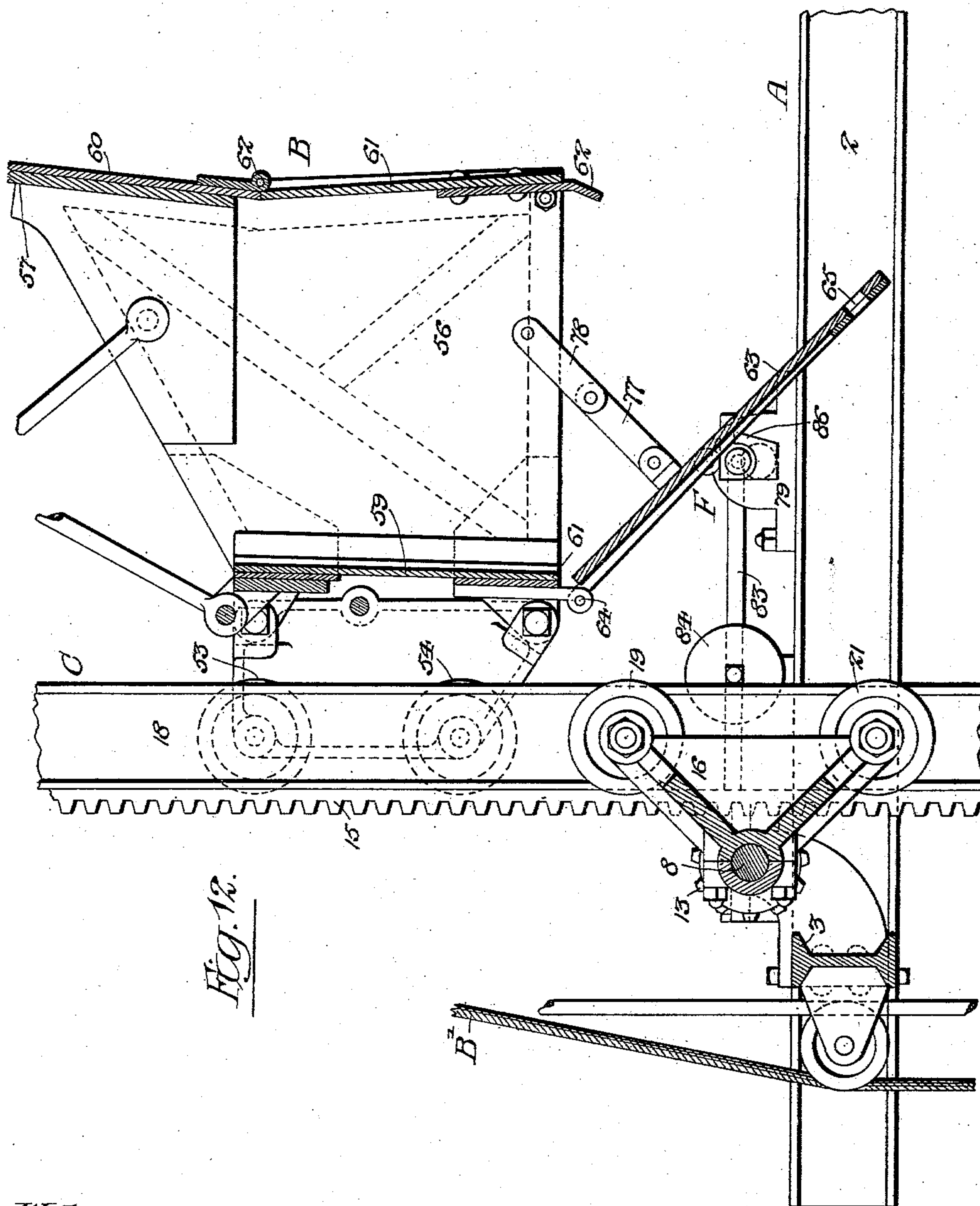
No. 741,099.

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F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

NO MODEL.

9 SHEETS—SHEET 5.



Witnesses:-  
Louis M. V. Whitehead  
Ottilie C. Freiburg

Inventor:-  
Frank M. Bisbee  
by Chas. E. Page  
Atty.

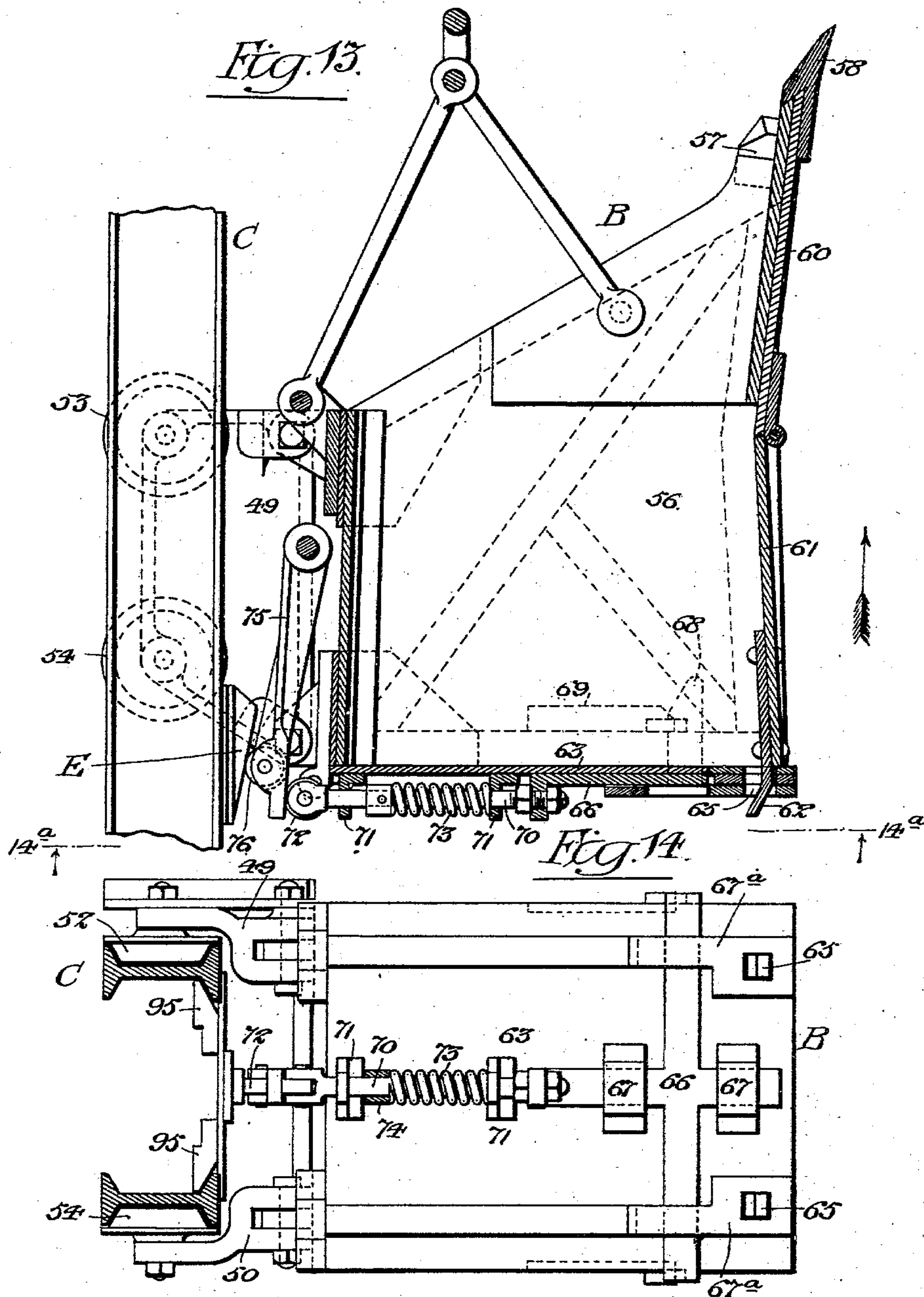
No. 741,099.

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F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

NO MODEL.

9 SHEETS—SHEET 6.



Witnesses:-

*Wm. L. Whitehead*

*Ottie C. Freiberg*

Inventor:-

*Frank M. Bisbee*  
*by Chas. G. Page*  
*Atty.*



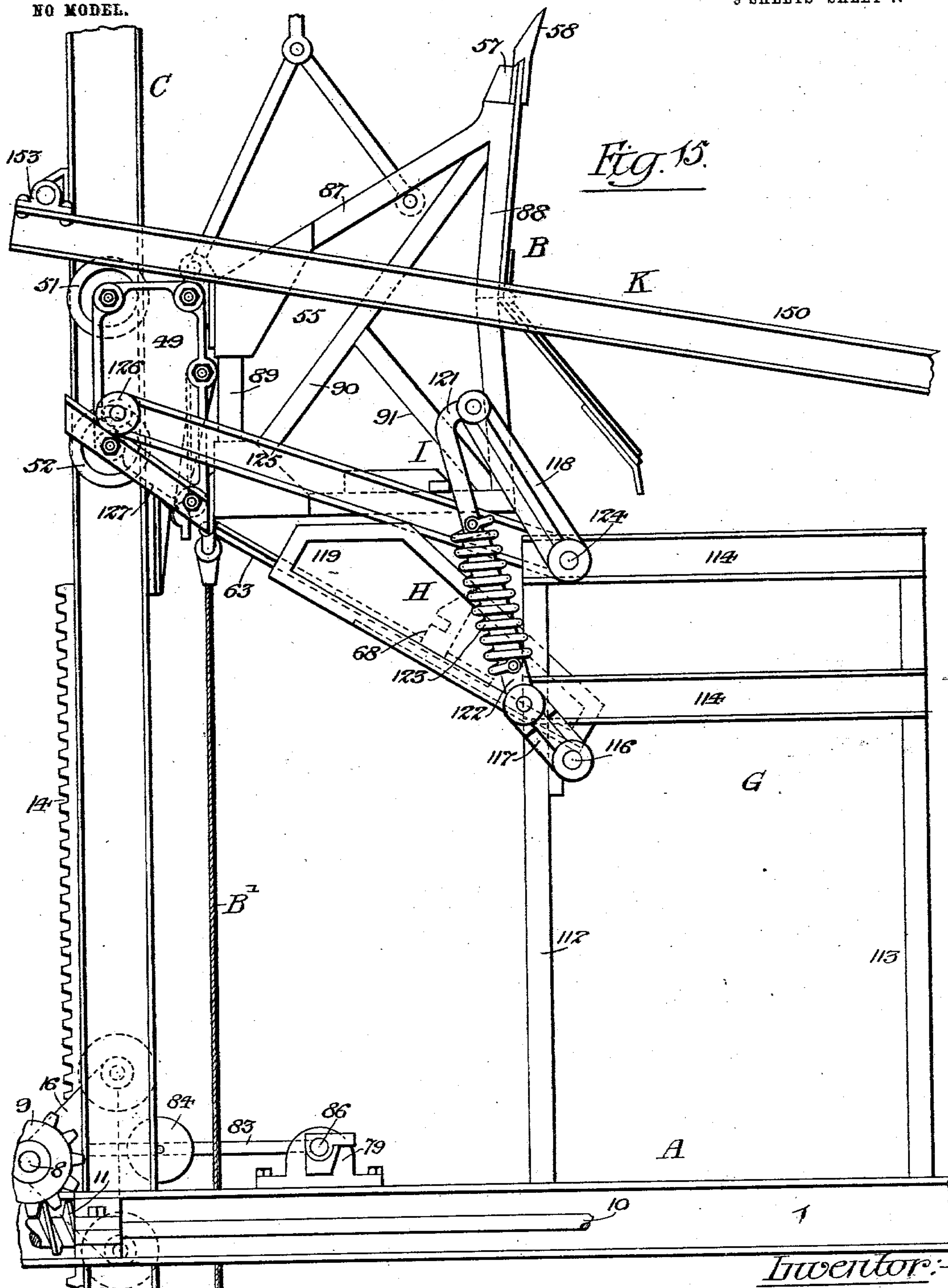
No. 741,099.

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F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

9 SHEETS—SHEET 7.

NO MODEL.



Witnesses:-

Wm. H. Whitehead

Ottob C. Fruebing

Inventor:-

Frank M. Bisbee  
by Chas. E. Page  
Atty.

No. 741,099.

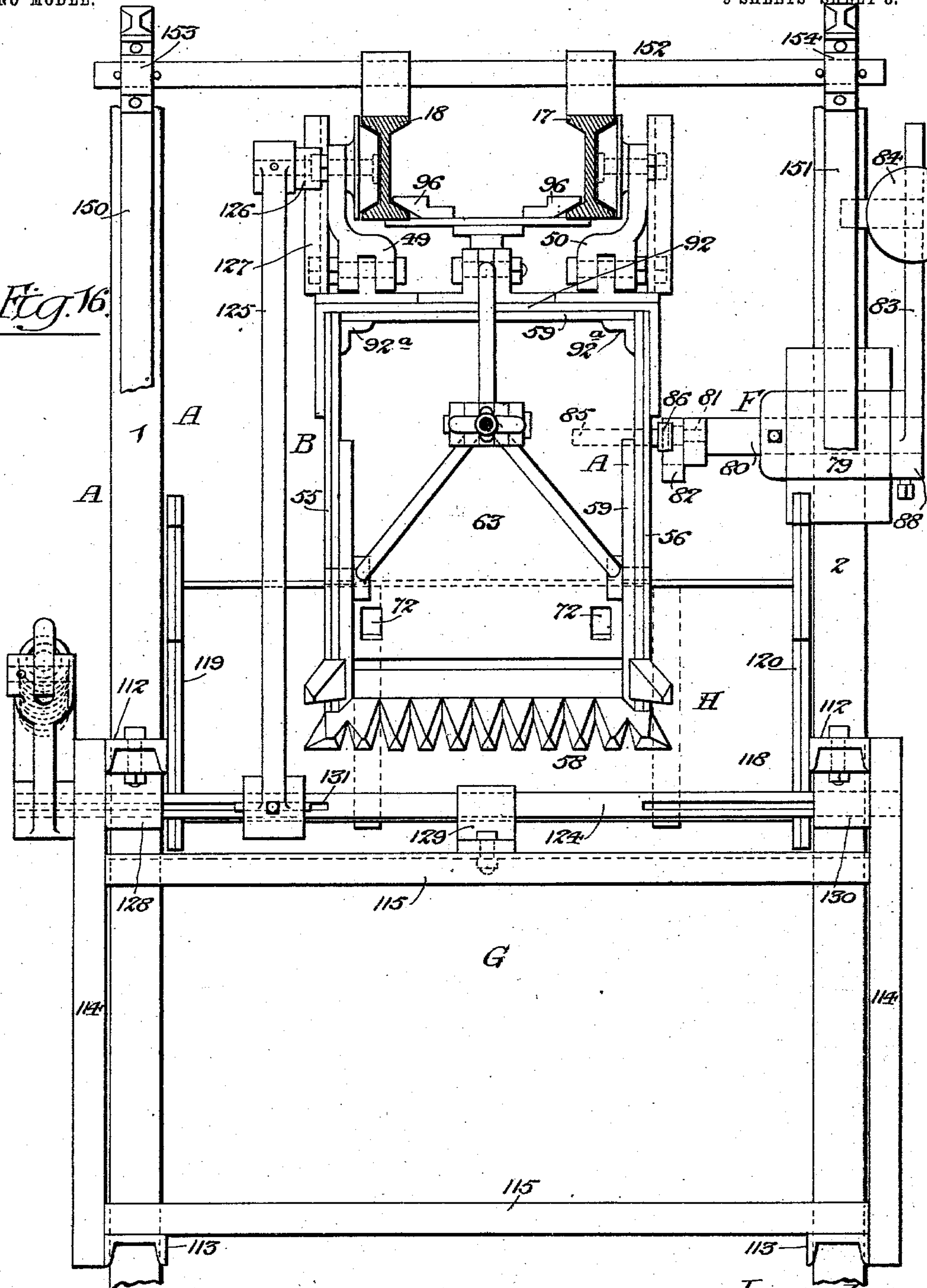
PATENTED OCT. 13, 1903.

F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

NO MODEL.

9 SHEETS—SHEET 8.

*Fig. 16.*



*Witnesses:-*

*Louis W. F. Whitehead*  
*Ottolie C. Freiburg*

*Inventor:-*

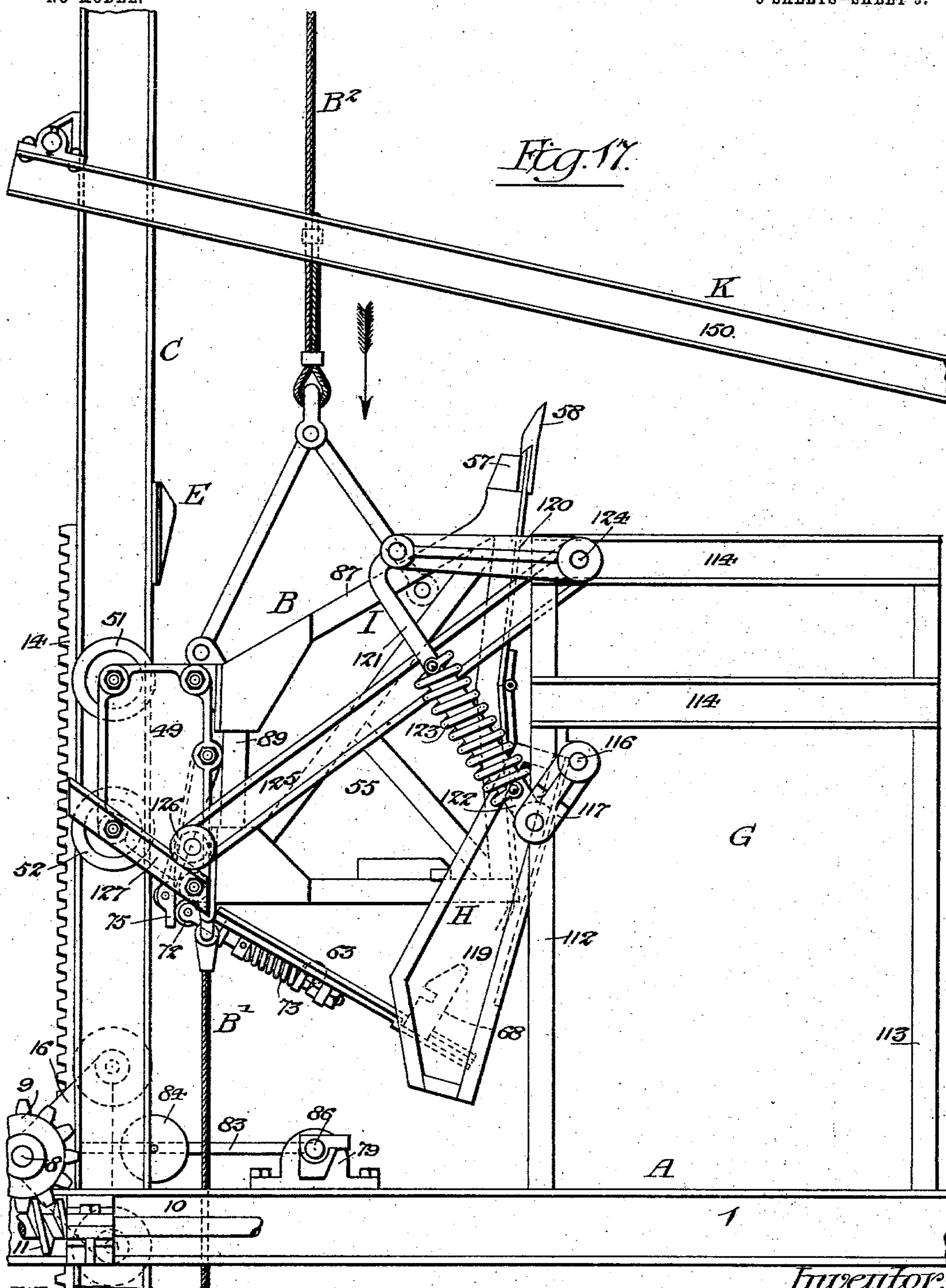
*Frank M. Bisbee*  
*by Chas. E. Page*  
*atty.*



F. M. BISBEE.  
EXCAVATING MACHINE.  
APPLICATION FILED JUNE 12, 1903.

NO MODEL.

9 SHEETS—SHEET 9.



Witnesses:-

Wm. M. Whitehead

Ottile C. Freiburg

Inventor:

Frank M. Bisbee  
by Chas. E. Page  
Att.



# UNITED STATES PATENT OFFICE.

FRANK M. BISBEE, OF CHICAGO, ILLINOIS, ASSIGNOR TO FREDERICK C. AUSTIN, OF CHICAGO, ILLINOIS.

## EXCAVATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 741,099, dated October 13, 1903.

Application filed June 12, 1903. Serial No. 161,120. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK M. BISBEE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Excavating-Machines, of which the following is a specification.

My invention is more particularly designed as an improvement upon the excavating-machine shown and described in my application for Letters Patent of the United States filed April 22, 1902, and serially numbered 104,148, and involving a swinging and longitudinally-movable boom supported to be extended downwardly into a trench or excavation in rear of the main or body frame of the machine and affording a track or way for an excavating-bucket arranged for up-and-down travel on the boom.

Objects of my invention are to permit the boom to occupy a vertical position, to conveniently dump the contents of the excavating-bucket when the boom is in such vertical position, to effectively discharge the contents of the excavating-bucket, to provide improved means for automatically opening and closing a door of the excavating-bucket, to automatically and effectively close such door after the contents of the bucket have been discharged, to automatically dump the excavating-bucket at a uniform elevation above the ground-line regardless of the depth of the trench or excavation and the extent to which the boom is lowered therein, to render the machine compact and permit matters discharged from the bucket to be delivered to a wagon at a point near the line of travel of the excavating-bucket, and to provide various improved matters of detail, combination, and arrangement serving to increase the general efficiency of excavating-machines.

In the accompanying drawings, Figure 1 is a sectional elevation of a portion of the machine, the section being on a vertical plane between the excavating-bucket and one of the side sills of the body-frame and indicated by line 1<sup>a</sup> 1<sup>a</sup> in Fig. 11. Fig. 2 shows the lower portion of the boom illustrated in Fig. 1, with its lower swinging section engaged by the excavating-bucket and swung back. This

view also illustrates the end wall of a trench undercut by the excavating device. Fig. 3 shows the upper portion of the boom in longitudinal section and mainly illustrates an adjustable cam or tripping device employed to operate a device for locking a door of the excavating-bucket. Fig. 4 is a section through a part of the boom portion shown in Fig. 3 on line 4<sup>a</sup> 4<sup>a</sup>, the devices for adjustably supporting the cam or tripping device E on the boom being shown in elevation. Fig. 5 is a section taken transversely through the boom on line 5<sup>a</sup> 5<sup>a</sup> in Fig. 4. Fig. 6 is a detail view showing a portion of the boom in elevation. Fig. 7 shows the upper end portion of the boom, partly in elevation and partly in vertical section, and illustrates a spring supporting device for the upper sheave 33. Fig. 8 is a section on line 8<sup>a</sup> 8<sup>a</sup> in Fig. 7. Fig. 9 shows in elevation the upper portion of the boom and a sheave-support D, provided with a couple of sheaves respectively for one and the other of the two cables employed. Fig. 10 is a front elevation of the boom portion and attachment shown in Fig. 9. Fig. 11 is a sectional plan, the plane of the section being through the boom and excavating-bucket on line 11<sup>a</sup> 11<sup>a</sup> in Fig. 1. Fig. 12 is a vertical section on line 12<sup>a</sup> 12<sup>a</sup> in Fig. 11, the bottom door of the excavating-bucket being in an open position. Fig. 13 shows the excavating-bucket in vertical section and a portion of the boom in elevation, the bottom door of the excavating-bucket being closed and locked and the latch device for locking such door being partly in section and partly in elevation. In this view the excavating-bucket is opposite the cam E, employed for actuating the latching device so as to unlock its bottom door. Fig. 14 is a bottom plan of Fig. 13, the boom being in section on a plane indicated in Fig. 13 by line 14<sup>a</sup> 14<sup>a</sup>. Fig. 15 shows a portion of the machine in side elevation and illustrates the act of dumping the contents of the excavating-bucket, the doors of such bucket being open and the swinging chute H being in position to receive the load. Fig. 16 is a plan view of the portion of the machine represented in Fig. 15, the boom being in cross-section. Fig. 17 is a view similar to



Fig. 15, with the excavating-bucket lowered to some extent and the chute H swung down from the position shown in Fig. 15.

The main or body frame A, of which I have shown a portion sufficient for the purposes of this application, can be of any suitable construction. The portion of the body-frame thus illustrated comprises a pair of horizontally-arranged sills or side bars 1 and 2, tied together at one end of the structure by a cross-bar 3, as in Fig. 11.

The excavating bucket or shovel B is arranged to traverse a beam or boom C, having a combined swinging and longitudinally-shifting connection with the main frame, so as to permit its adjustment with reference to the character of the work and conditions involved. In order to thus connect the boom with the main frame, the latter is provided with bearings or journal-boxes 4, 5, 6, and 7, Fig. 11, all relatively in alinement and adapted for supporting a transversely-arranged rotary shaft 8, the boxes 4 and 5 being secured upon the end cross-bar 3 of the main frame and the boxes 6 and 7 being secured upon the longitudinal sill portions 1 and 2 thereof. The boom is shifted by means of gear connection with the rotary shaft 8 and is tied to such shaft by a shifting connection hung to swing about the axis of the shaft, whereby the beam is, in effect, fulcrumed upon the rotary shaft and arranged to slide or shift longitudinally and independently of its fulcral support. More specifically referring to details involved, the rotary shaft 8 can be rotated in opposite directions in alternation by suitable actuating mechanism, such as a worm-wheel 9 on the shaft and a rotary worm-shaft 10, provided with a worm 11, which engages the worm-wheel 9. The rotary shaft 8 is provided with pinions 12 and 13, keyed thereon and arranged between the boxes 4 and 5. These pinions engage longitudinally-extending racks 14 and 15 on the boom, which is tied to the shaft 8 by a swinging casting or bearing 16, hung upon the shaft at a point between the pinions 12 and 13 and adapted to maintain the racks in engagement with the pinions and at the same time permit the boom to swing and also to shift longitudinally. In order to permit the boom to thus shift longitudinally and independently of the swinging bearing 16, the latter is provided with flanged idler rolls or wheels 19, 20, 21, and 22, Figs. 1, 11, and 12, arranged with their treads in engagement with longitudinal inner side portions of the boom, which is preferably composed of a pair of parallel I-beams 17 and 18, tied together at their upper and lower ends by means of any suitable connections. With such construction the I-beams 17 and 18 as a matter of course have each a couple of longitudinal channels respectively at opposite sides of its web portion, the rolls 19 and 21 being confined within one of such channels of one I-beam, and the rolls 20 and 22 being confined within a

like channel of the other I-beam. The diameter of each roll is less than the width of the channel in which it is thus confined, and hence when the boom is shifted longitudinally the rolls while engaging the inner faces of certain flanges of the I-beams will be free to revolve, so as to allow free end movement on the part of the boom. By means of the rack-and-pinion device thus described the boom can be raised and lowered, and by reason of the swinging connection of the beam with the shaft 8 the beam can be swung about its fulcral support in a vertical plane and also brought into and held in a vertical position, so as to permit the excavating-bucket to operate upon the vertical end wall of a trench or sewer and to undercut such wall, as illustrated in Fig. 2, which shows a bank or wall thus undercut.

In order to permit the excavating-bucket to have an effective and highly-desirable range of action, whether the boom C is in a vertical or inclined position, but particularly when the boom occupies a vertical position, as in Figs. 1 and 2, the lower end portion of the boom consists of a relatively swinging section 23, composed of a pair of short lengths of I-beams corresponding in cross-section with the main lengths 17 and 18 of I-beams and respectively hinged thereto, as at 24, Figs. 1 and 2, the arrangement being such that when the independently-swinging boom-section 23 is in alinement with the main section it will simply form a downward extension thereof. The swinging sections 27 are tied together in any suitable way—for example, by a transversely-extending casting 28, which also affords a bearing for a couple of oppositely-positioned sheaves 29 and 30, about which passes a rope or cable B', employed for drawing down the bucket. By such arrangement the bucket can be lowered until it is brought into position upon the lower swinging section 23 of the boom, and at such juncture the lower swinging section will swing back, as in Fig. 2, thereby breaking joint and carrying the bucket in the arc of a circle about the point of hinged connection between the lower and upper sections.

When the lower boom-section 23, with the excavating device or bucket thereon, is swung back to the position shown in Fig. 2, the excavating device or bucket will be in readiness for reverse bodily swing for the purpose of excavating, and to cause such reverse movement a rope or cable B<sup>2</sup> is attached to the forward or upper end of the bucket in opposition to the rope or cable B', which is attached to the back or lower end of the bucket. In order to guide the cable B<sup>2</sup> when the lower boom-section 23, with the bucket thereon, is swung back, the upper boom-section is provided at its lower end with a sheave 31, supported between the two I-beam portions 17 and 18, so that when section 23, with the bucket thereon, is being swung back to the position as in Fig. 2 a portion of the oper-



ating rope or cable B<sup>2</sup> will take and be guided by sheave 31, as illustrated.

In order to limit the extent of back swing on the part of section of the boom, the upper longer boom-section is provided with an elastic buffer 32, Fig. 1, arranged upon a casting 32<sup>a</sup>, which can in turn be employed as a rigid connection between the lower end portions of the two bars or beam portions 17 and 18 of the upper boom-section. The upper ends of these I-beams can be rigidly tied together by any suitable device, such as a transversely-arranged connection 32<sup>b</sup>, Figs. 7, 8, and 10.

As an upper guide for the cable B' the upper end of the boom C is provided with a sheave 33, (see particularly Fig. 7,) which is arranged between the two beams 17 and 18 of the boom and journaled upon boxes or bearings 34, Figs. 7 and 8, having limited sliding connections with the boom and supported by strong springs 35, the said boxes or bearings being, for example, provided with studs 34<sup>a</sup>, arranged to engage in vertical slots 36 in frames or brackets 36<sup>a</sup>, which are secured to opposite side portions of the boom and adapted to permit the springs 35 to engage the boxes or bearings 34 and seat at their lower ends upon brackets or bearings 36<sup>b</sup> on the boom. As a means for further guiding the cables B' and B<sup>2</sup> the boom is provided on what may be termed its "forward" face with a sheave support or structure D, Figs. 9 and 10, comprising castings 37 and 38, tied together by cross rods or shafts 47 and 48 and supporting sheaves 45 and 46, respectively. The castings 37 and 38 stand out from the boom, as illustrated in Fig. 9, and have their lower ends supported and secured to the boom by inclined brace-rods 39 and 40, their upper ends being in like manner supported and secured to the boom by inclined brace-rods 41 and 42. This sheave support or structure is also further trussed by the rods 43 and 44. With this construction the sheave 45 affords a guide-support for the cable B' at a point forward of the boom, while the sheave 46 provides a guide-support for the cable B<sup>2</sup> at a point below the sheave 45, the excavating-bucket B having, in effect, a sliding or shifting connection with the boom and is arranged to traverse substantially the length of the same, the direction in which said excavating device is moved being effected by one or the other of the two cables. The cable B', attached to the lower end of the bucket, passes about sheaves 29 and 30 on the lower swinging boom-section and extends from such sheaves upwardly to and over the upper sheave 33, thence passing to and over sheave 45, and thence passing to some suitable winding device, such as a winding-drum, and in order to permit the lower boom-section to swing back when the bucket has been drawn upon it the portion of the cable B' between said upper and lower sheaves is deflected laterally back from the boom by means of a

guide-sheave 49, Fig. 1, supported upon the rear end of the body-frame at a point back of the shifting pivotal connection between the boom and the body-frame. The winding-drum can be positioned upon the body-frame forward of the boom, it being regarded as only necessary to indicate the presence of such drum by dotted lines in Fig. 1. By operating the winding-drum in a direction to wind the cable B' thereon and pay out cable B<sup>2</sup>, which can also be attached to such winding-drum, the bucket will be drawn down and then caused to swing back to the position shown in Fig. 2. Movement of the shovel or bucket in an opposite direction is effected by the rope or cable B<sup>2</sup>, attached to the upper or forward end portion of the shovel or bucket and trained over the sheave 46 and thence carried to the winding-drum, whereon it will be wound reversely to the winding of the cable B'. In order to operate the bucket, the winding or hoisting drum is started up in a direction to permit the bucket to descend from the position shown in Fig. 1, and when the bucket is fairly on the lower swinging section 23 of the boom the action of the rope or cable B', passing about sheaves 29 and 30 at the end of the boom-section 23, will cause the latter to swing back to the position shown in Fig. 2, and thereby permit a comparatively slight downward adjustment of the boom to position the bucket for excavating, it being already explained that when the boom-section 23 thus swings back the rope or cable B<sup>2</sup> will at a suitable moment take the sheave 31 at the lower end of the upper boom-section, as illustrated in Fig. 2. After the bucket has been thus positioned the operator will reverse the movement of the winding-drum, whereby cable B' will pay out and cable B<sup>2</sup> will be drawn in a direction to swing the lower boom-section into alinement with the upper boom-section and then elevate the bucket, which during the first portion of such movement will be carried in the arc of a circle, so as to cut into the earth and load itself, as indicated in Fig. 2.

In order to maintain the bucket in engagement with the boom and at the same time permit it to readily traverse the same, the bucket is provided with castings or arm portions 49 and 50, rigidly bolted to the bucket and forming bearings for four flanged rolls or wheels 51, 52, 53, and 54, which are arranged to traverse guideways formed by the outer longitudinal channels of the I-beams of which the boom is composed, it being observed that the boom has four of such guideways, the rolls on the bucket being arranged to traverse the two outer guideways, while the anti-friction-rolls on the hinged arm or bearing 16 are arranged to engage in the two inner guideways formed along the inner opposing sides of the I-beams. Each of said rolls is of course slightly less in diameter than the width of the channel or guideway in which it engages. The excavating shovel or bucket B is con-



constructed with opposite sides 55 and 56, Figs. 12 and 16, reinforced by marginal and diagonally-arranged stiffening-bands and formed to incline along their upper edges in a direction upwardly and rearwardly from the boom when the bucket is in the position shown in Fig. 12, the end portion 57 of the bucket being provided with a suitable blade or blades—for example, with spuds 58—which pitch outward relatively to the boom when the bucket is in the position last mentioned.

The sides 55 and 56 are secured to a rear side wall 59 and have their forward edges secured to an upper front wall portion 60, Fig. 12, which inclines downwardly and inwardly. To the lower edges of this front wall portion is hinged a door 61, adapted to normally close the bucket at its front side, the door when thus closed being arranged to slope downwardly and outwardly from its hinge connection 62 with the bucket, whereby when the bucket is in the position shown, for example, in Fig. 12, the door will be normally maintained by gravity in a closed condition. The hinge connections between the door and bucket are arranged at the point of greatest lateral inward depression of the front portion of the bucket, whereby rubbing of the hinges against a bank which is being excavated will be avoided. One or more catches 62 are secured to the lower end of this swinging front door or gate and arranged to project below the plane of the bottom of the bucket. The bottom of the bucket is essentially formed by a door 63, hinged to the rear wall, as at 64, Fig. 12, and provided near its outer free edge with one or more openings 65, adapted to receive the catch or catches 62 on the front door when it is closed, in which way the engagement of the front door 61 with the closed bottom door 63 will of course hold the front door in a closed condition. In order to hold the bottom door closed, it is provided on its under side with a cross-shaped sliding latch 66, Fig. 14, which is maintained upon the door by guide-straps 67 and 67<sup>a</sup>. This latch 66 is provided at opposite sides with upwardly-extending catch portions arranged for engaging keepers secured to opposite sides of the bucket, one of said catch portions 68 and one of said keepers 69 being shown in dotted lines in Fig. 13. To the rear end of the latch-plate 66 is secured a forked slide-bar 70, supported upon the bottom of the bucket by guides 71 and arranged to project beyond the rear wall of the bucket. The rear forked end of this forked slide-bar 70, which projects beyond the rear wall of the bucket, is provided with an idler-roll 72, and between the guides 71 71 is arranged a strong spring 73, coiled about the slide-bar 70. This spring has one end bearing against one of the guides 71 and its opposite end bearing against a collar 74, fixed on the forked slide-bar 70, the normal condition of such spring causing the latch-plate 66 to engage the keepers 69 on the sides of the bucket, and thereby keep the bottom

door locked. Between the rearwardly-projecting bucket-arms 49 and 50, which carry rolls for engaging the boom, as hereinbefore described, is hung an arm 75, Fig. 13, the lower end of which impinges upon the face of roller 72 on the forked latch-bar 70. This hinged swinging arm is also provided near its lower end with a roller 76, which is provided for engaging the inclined face of a trip or cam projection E on the boom at a time when the bucket is brought into position to permit such engagement for the purpose of dumping the contents of the bucket, as follows: The cam E is held upon the boom at a point suitable for dumping the load, and the bucket having been loaded with excavated soil and being drawn upwardly along the boom the roller on the swinging arm 75 will engage the lower inclined face of the cam E, and said arm will thereby be caused to swing in a direction laterally forward from the boom, and in thus swinging forwardly it will by reason of its engagement with the latch-roll 72 force forward the forked slide-bar 70, which will shift the latch 66 forwardly, and thereby free the latch-plate from its engagement with the keepers. This forward shift of the latch, of which the slide-bar 70 may be regarded as a part, will compress the latch-spring 73, so that when arm 75 is released from the cam E the latch-spring will act to restore the latch to its first position. When the bottom of the bucket is thus unlatched, the weight of the load will swing it downwardly, and thereby permit its contents to drop out, and of course as soon as the catch or catches 62 on the lower end of the front door are freed from engagement with the bottom door by reason of the down swing of the latter the front door will also be swung outwardly to some extent by the load, thereby permitting a quick clean discharge of the contents of the bucket. In order to limit the extent of down swing on the part of the bottom of the bucket, said bottom has a jointed stop connection with the body of the bucket, consisting of links 77 and 78, Fig. 12, pivotally connected together and respectively attached to the swinging bottom and to the body of the bucket, the length of such link connection when the links are in alinement, as in Fig. 12, being such as to permit the swinging bottom to incline downwardly and away from the boom, and thereby deflect the falling soil away from the latter. As soon as the soil has been discharged from the bucket the front side door of the bucket will close by gravity, and in order to automatically close the bottom door a door-closing device F, Figs. 12 and 16, is provided. This door-closing device comprises a bearing 79, which is secured upon the body-frame sill 2 and recessed or bored to receive a transversely-arranged rock-shaft 80. One end, termed the "inner" end, of this rock-shaft 80 has a head 81, to which is pivoted a tappet 82, Fig. 16, arranged to swing upwardly free of the rock-shaft. The opposite end of the rock-shaft is provided with an



arm 83, to which is adjustably attached a counter-weight 84. Upon this swinging bottom door of the bucket is a bracket or bearing 85, which is in a vertical line passing through the center of the rock-shaft when the said bottom door is open, and this bracket is provided with an idler-roll 86, as in Fig. 16, which said roll projects laterally over the tappet 82 on the rock-shaft. When, therefore, the bucket has been unloaded and is caused to descend, the roll 86 will engage the tappet 82, whereby further down movement of the door with the bucket is arrested, while at the same time further descent on the part of the body of the bucket will cause its bottom door to close, and in so doing the roll 86 will move along the face of the tappet 82 toward the free outer end of the latter. When the bottom door is thus fully closed, the latch-plate 66 will engage the keepers on the bucket, and as the arm or tappet 82 on the rock-shaft is at such juncture still engaged by the roll on the bucket said arm or tappet will receive the full weight of the bucket, and thereby swing down and axially turn the rock-shaft in opposition to the counter-weight thereon until by further descent on the part of the bucket the roll 86 leaves the said arm or tappet 82, and thereupon the action of the counter-weight will restore the rock-shaft and tappet or arm thereon to their normal position. After the bucket has descended into the excavation and has taken its load and while it is again ascending the roll 86 will engage the tappet or arm 82 on the rock-shaft 80 and swing such tappet or arm 82 upwardly and independently of the rock-shaft, so as to permit said roll to pass the arm or tappet.

The excavating-bucket can be formed and braced in any suitable way, the bucket shown being provided with marginal stiffening-bands 87, 88, and 89 upon opposite sides, said sides being also further reinforced by diagonal stiffening straps or bands 90 and 91, and the connection between the sides 55 and 56 and the rear wall 59 being further braced by outer stiffening-plates 92 and inner angle-braces 92<sup>a</sup>, Fig. 16. The machine thus described is adapted for digging trenches or excavations of various depths, the depth of the excavation being governed by the adjustment of the boom which carries the excavating shovel or bucket. The point of dumping elevation is, however, preferably invariable as to elevation above the ground-line regardless of the depth of the trench or excavation, and for this reason the cam or tripping device E is adjustably held upon the boom, as illustrated in Figs. 3, 4, 5, and 6. As therein shown it comprises a plate 93, arranged to slide along the I-beams 17 and 18 and having as a sliding connection therewith castings or bearings 95 96, provided upon its rear side and engaging the said I-beams, as best shown in Figs. 14 and 16. Upon these castings or bearings 95 96 are mounted adjustably-sliding grip-shoes 97 98, adapted and

arranged to engage and hug the webs of the I-beams 17 and 18, and impinging against the inner faces of these grip-shoes are two toggle-levers 99 100, pivoted together at their inner ends and arranged to swing about fulcrum 102 103, adjacent to the inner faces of the grip-shoes. Embracing the connecting pivot-pin 100<sup>a</sup> of the toggle-levers 99 100 is a double clevis 104, a rope or cable 105 being attached to the upper portion of said clevis and arranged to extend up to and over a sheave 106, which is mounted in a bracket 107 on the upper end of the plate 93. From this sheave 106 the cable drops to within reach of a person on the ground when the cam or trip device E is at the highest desired point, and it then returns and is attached to the lower portion of the clevis 104, as in Fig. 3. A single clevis 108 is fastened to the sheave-bracket 107, and to this clevis 108 is secured a cable 111, which passes up to and about a sheave 110, mounted upon the upper end portion of the boom. From the sheave 110 the said cable 111 passes down and is attached to a point near the ground—for example, as in Fig. 1. To the forward face of the plate 93 is secured the casting 94, which serves as a cam E for effecting the closing of the bottom door of the bucket, as hereinbefore mentioned. When it is desired to shift the elevation of the cam E, the attendant will pull upon the lower portion of cable 105, and this will release the toggles from the grip-shoes, so as to ease the pressure of the latter upon the webs of the I-beams 17 and 18. The cam can then be raised or lowered by the cable 111, and when in desired position a pull on the upper part of cable 105 will so adjust the toggle as to cause the grip-shoes to firmly engage the I-beams. A stop-pin 101, Fig. 4, is provided to limit the action of the toggles and to check them when brought to the point where greatest pressure is secured. The faces of the grip-shoes which engage the beams can also be faced with leather or roughened to increase frictional engagement with the web portions of the beam, and thereby prevent accidental slip.

With reference to means for receiving the matters discharged from the bucket and for delivering the same at a desired point, G, Figs. 15 and 17, indicates a superstructure arranged upon the body-frame and positioned to permit the ascending and descending bucket to just clear it. This superstructure comprises standards 112 and 113, preferably four in number and rigidly secured upon the body-frame. These corner posts or standards are connected by longitudinal braces 114 and transverse braces consisting of channel-bars 115, as in Figs. 15, 16, and 17.

The space between the posts 112 113 and under the longitudinal rails 114 is sufficient to permit the passage of a car, cart, wagon, or other dirt or earth carrying conveyance. To the corner-posts 112 and extending transversely across to the opposite side at a height



from the sills about equal to the height of a wagon-box is journaled a shaft 116, and on this shaft between the posts 112 is firmly attached a chute H, Figs. 15, 16, 17, which said chute has side walls 119 120. The free end of this chute or apron is adapted to swing out and under the bucket D, as shown in Fig. 15.

To one of the extremities of the shaft 116 is attached a short arm or lever 117, which is connected at its free end by means of an adjustable connection I to a long lever or arm 118, Fig. 15, firmly attached to a transverse shaft 124. This shaft is journaled in boxes 128 130 129, the boxes 128 and 130 being bolted to the upper ends of the corner-posts 112 and the box 129 being secured to the cross-rail 115. The shaft 124 is located directly above the shaft 116 and carries between the posts 112 a long lever 125, whose free end extends back past the bucket to engage with a shelf 127, affixed to the bucket carriage or carrier comprising the arms or plates 49, a roller 126 being attached to said lever at its free end to reduce friction between it and said shelf.

The adjustable connection I comprises a tubular member 122, fixed at one end to the short lever 117. Into the opposite end of this member is fitted to slide the lower extremity of a solid member 121, whose upper end is fixed to the long arm 120. These members 122 and 121 are connected together by a heavy helical spring 123 encircling the member 122, the whole forming a longitudinally-adjustable connection between the arms or levers 117 120. The operation of this mechanism may be described as follows: The apron H normally hangs from the shaft 116 and between the posts 112. The positions assumed by the various levers will then be about as shown in Fig. 17. After the bucket has reached the desired elevation the shelf or trip device 127 on the bucket-carriage comes in contact with the end of long arm 125 and swings such arm upwardly. Motion from this arm is communicated to the shorter arm 120 through shaft 124, and said arm 120 in turn imparts motion to the still shorter arm 117 by means of the flexible connection I, the swing of the arm 117 thereupon operating shaft 116 in a direction to swing the apron upwardly and under the bucket, the apron finally arriving at the position shown in Fig. 15. At such juncture the bucket-doors open and drop the contents upon the apron, which diverts the soil into a wagon or cart within the space of the frame or superstructure G.

The interposition of a flexible connection between the arms 117 and 120 is made necessary by reason of the fact that the bucket ascends at a high speed and the strain upon the arms would be too great at the instant when the long arm engages the shelf on the bucket-carriage were the connections solid throughout. The boom is preferably maintained in a vertical position, and to accom-

plish this there is attached to it about one-third of the distance from the top a guy-frame K. This frame consists of two beams 150 151, connected to the beams 17 and 18 of the boom by a shaft 152 and boxes 153 154. The guy-frame constitutes a push or pull device operating as a pitman and connected with the boom above the fulcrum of the latter, and as my Patent No. 733,939, dated July 21, 1903, illustrates a way in which this device can be operated and also claims the same special illustration of operating mechanism is not necessary.

What I claim as my invention is—

1. In an excavating-machine, a boom having its lower end portion consisting of an independently-swinging hinged section; an excavating device supported to traverse the boom and arranged to descend thereon to an extent to engage upon the lower hinged section; a cable attached to and extending downwardly from the excavating device to guide means on the lower hinged boom-section and thence extending upwardly; and a guide device for said cable supported in rear of the boom and serving to deflect rearwardly from the boom the portion of such cable between said guide device and the cable-guiding means on the lower hinged boom-section.

2. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having its bottom portion constructed with a downwardly-swinging door; a device for locking said door in a closed condition; and a device for automatically unlocking such door when the bucket in its ascent has reached a point suitable for dumping.

3. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having its bottom portion constructed with a downwardly-swinging door; a device for locking the door in a closed condition; a device for automatically unlocking the door when the bucket in its ascent has reached a point suitable for dumping; and a door-closing device operating to automatically close the door during the descent of the bucket.

4. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having its front and bottom portions each constructed with a swinging door; and means for automatically locking said doors in a closed condition; the bottom door being hinged to the rear portion of the bucket, and the door at the front side being arranged to hang as a gravity-door from its hinged connection with the bucket and to swing outwardly under pressure of matters within the bucket when it is unlocked, and to swing back by gravity into its normal closed position after the contents of the bucket has been discharged.



5. In a ditching and grading machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having its front portion constructed with a suspended swinging door normally assuming a closed position, and its bottom portion constructed with a swinging door hinged at its rear part and having its forward free part adapted to engage with and lock the said suspended front door when the latter is closed and the said bottom door is swung upwardly into closed position.

6. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a hinged bottom door hung at its rear part, and a suspended, swinging front door normally closed by gravity, the forward free part of the bottom door being provided with an opening and the lower edge portion of the front door being provided with a catch which engages in said opening in the bottom door when the latter is swung up into a closed position.

7. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging bottom door; a device for locking the bottom door in a closed position; and a cam projection on the boom for automatically actuating said locking device and causing it to unlock the bottom door during the ascent of the excavating-bucket along the boom.

8. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging door; a device for locking the swinging door in a closed position; and a device for actuating such locking device supported for adjustment in position along the boom, and causing the locking device to unlock the door during the ascent of the bucket and at a point determined by its adjustment in height upon the boom.

9. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a bottom door; a device for locking such bottom door in a closed position; and a device for actuating such locking device supported for adjustment in position along the boom, and causing the locking device to unlock the bottom door during the ascent of the bucket and at a point determined by its adjustment in height upon the boom.

10. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging bottom door; a device

for locking the swinging bottom door when such door is closed, and normally in locking position; and a cam adjustable in position along the boom and adapted for engaging and actuating the locking device to unlock the door at a time during the ascent of the bucket.

11. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging bottom door; means for locking such door in a closed position comprising a spring-controlled sliding latch device; a swinging arm attached to the bucket and arranged to engage the sliding latch device; and a cam arranged upon the boom in position to engage and swing said arm during the ascent of the bucket and thereby shift the latch in opposition to its spring and in a direction to unlock the swinging door.

12. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged to travel up and down on the boom and having a swinging door; a device for locking the swinging door in a closed position; a tripping device for operating such locking device adjustably held upon the boom; and a cable for adjusting the tripping device along the boom.

13. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel upon the boom and having a swinging door; a device for locking the door in a closed position; a tripping device for actuating such locking device supported for up-and-down adjustment upon the boom; means for adjustably supporting the tripping device comprising a shoe arranged to engage the boom; a toggle for adjusting the shoe; and a cable for operating the toggle.

14. In an excavating-machine, a boom constructed with a pair of longitudinally-extending beams and supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging door; a device for locking the door in a closed position; a cam for operating the door-locking device supported for up-and-down adjustment upon the boom; means for adjustably supporting the cam on the boom comprising shoes arranged to engage the beams of which the boom is constructed; a toggle for adjusting the shoes; a cable for operating the toggle; and a cable for raising and lowering the toggle, shoes and cam as a whole.

15. In an excavating-machine, a boom supported to be extended downwardly in a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging door; a latch device arranged upon the swinging door and having a roll; an arm hung upon the bucket and having a roll; a cam supported for up-and-down ad-



justment on the boom and arranged to be engaged by roll 76 on said arm as a means for operating the latch device during the ascent of the bucket.

5 16. In an excavating device, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging door; a device for  
10 locking the door in a closed position; a plate arranged to slide upon the boom and provided with a cam for operating the door-locking device during the ascent of the bucket; a toggle having its members 99 and 100 sup-  
15 ported upon said sliding plate; shoes engaging the boom and adjusted by the toggle; a cable passing over a sheave 110 on the boom and connected with the slide-plate; and a cable 105 passing over a sheave on the slide-  
20 plate and attached to the toggle.

17. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom  
25 and having a swinging bottom door which is hinged at the side of the bucket nearest the boom; and a stop device arranged to arrest the downward swing of the bottom door when the latter has reached a position in which it  
30 inclines downwardly away from the boom.

18. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom  
35 and having a swinging bottom door hung at the side of the bucket nearest the boom; and a jointed swinging stop device connecting the swinging door with the bucket and limiting the downward swing of said door to an in-  
40 clined position.

19. In an excavating-machine, a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom  
45 and having a swinging bottom door; a locking device comprising a catch on the bucket; a sliding latch-plate 66 on the door, and a spring normally maintaining the latch-plate in position to engage the catch on the bucket;  
50 and a latch-tripping device adjustably supported on the boom.

20. In an excavating-machine, a boom supported for longitudinal adjustment and arranged to be extended downwardly into a  
55 trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging door which opens to permit the discharge of the contents of the excavating-bucket; a device for locking the  
60 door in a closed position; a device for actuating such locking device to unlock the door during the ascent of the excavating-bucket, said device being supported for up-and-down adjustment on the boom; and a device on the  
65 body-frame of the machine positioned and adapted for engaging and automatically clos-

ing the door during the descent of the excavating-bucket.

21. In an excavating-machine, a boom supported to be extended downwardly into a  
70 trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a swinging door; and a door-closing device arranged upon the body-frame of the machine and comprising a yielding tappet  
75 normally in the path of a bearing on the door of the excavating-bucket, and a yielding resistance such as a movable weight arranged in opposition to yield on the part of the tap-  
80 pet when engaged by the bearing on the door during the descent of the excavating-bucket, said tappet having sufficient range of movement to permit the bearing on the door to  
85 clear it after it has served to close the door of the descending excavating-bucket, and to also permit such bearing to move it out of the way during the ascent of the excavating-bucket.

22. In an excavating-machine, a boom supported to be extended downwardly into a  
90 trench or excavation; an excavating-bucket arranged for up-and-down movement on the boom and having a swinging door; and a door-closing device arranged upon the body-frame of the machine and comprising a rock-shaft  
95 having a weighted arm, a tappet normally in the path of a bearing on the door and supported upon the rock-shaft to swing upwardly and independently of the rock-shaft when engaged by the bearing on the door during the  
100 ascent of the bucket, and to turn the rock-shaft in opposition to the weighted arm when engaged by said bearing during the descent of the door, the resistance of the weight being such to cause the tappet to close the  
105 door of the descending bucket and then permit the bearing on the descending bucket to depress and clear the tappet.

23. In an excavating-machine, a body-frame; a boom supported to be extended  
110 downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom; means for dumping the excavating-bucket in an elevated position; a swinging chute or apron supported upon the  
115 body-frame and arranged to swing into position to receive the contents of the excavating-bucket when the latter is dumped; and mechanism actuated by the ascending bucket to automatically swing the chute or apron into  
120 position to thus receive the matters thus dumped from the excavating-bucket, and also operative to permit the chute or apron to subsequently swing out of the way of the descending excavating-bucket.  
12

24. In an excavating-machine, a body-frame; a boom supported to be extended  
130 downwardly into a trench or excavation; an excavating-bucket supported for up-and-down travel on the boom and having a bottom door which is open to permit the bucket to dump its load; a swinging chute or apron



arranged to swing into position to receive the contents of the bucket when the latter is in an elevated position and its door opened, and to swing out of the way of the descending bucket; and means for automatically actuating the swinging chute or apron from the movement of the bucket.

25. In an excavating-machine, a body-frame; a boom supported to be extended downwardly into a trench or excavation; an excavating-bucket arranged for up-and-down travel on the boom and having a bottom door which is opened to dump the bucket when the latter is in an elevated position; a swinging chute or apron supported upon the body-frame and arranged to swing into position under the bucket when the latter is elevated

into position for dumping, and to swing from under the bucket when such bucket descends from its dumping position; and mechanism for actuating the swinging chute or apron comprising a vibratory arm which is engaged and operated by the ascending bucket, power-transmitting connection between such arm and the swinging chute or apron, and a yielding resistance such as a spring opposed to swing on the part of the chute or apron in a direction to place the same in position for receiving the contents of the bucket.

FRANK M. BISBEE.

Witnesses:

CHARLES G. PAGE,  
OTTILIE C. FREIBERG.