J. C. FRENCH.

GRADE LINE INDICATOR.

APPLICATION FILED SEPT. 24, 1917.

1,300,371.

Patented Apr. 15, 1919.

3 SHEETS—SHEET 1.

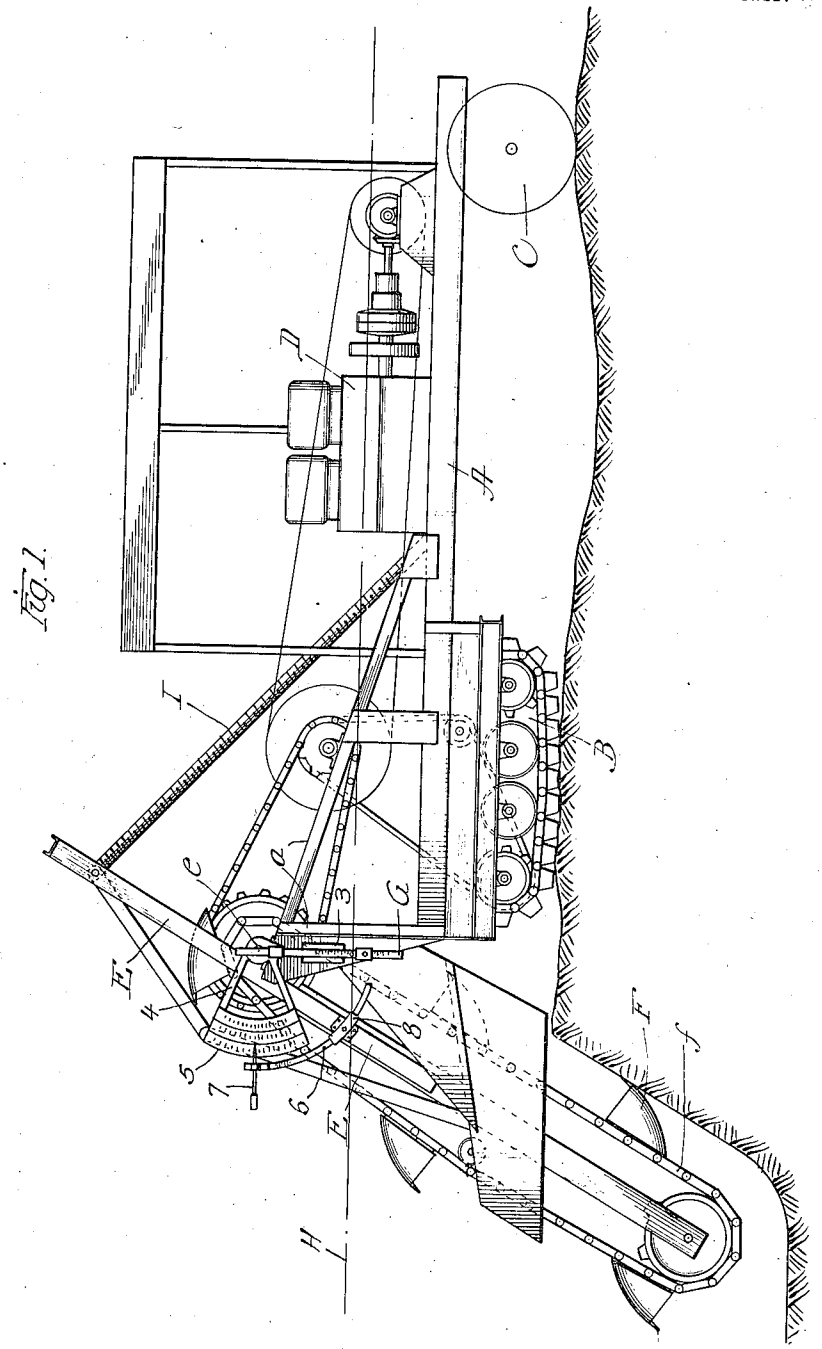


Fig. 1.

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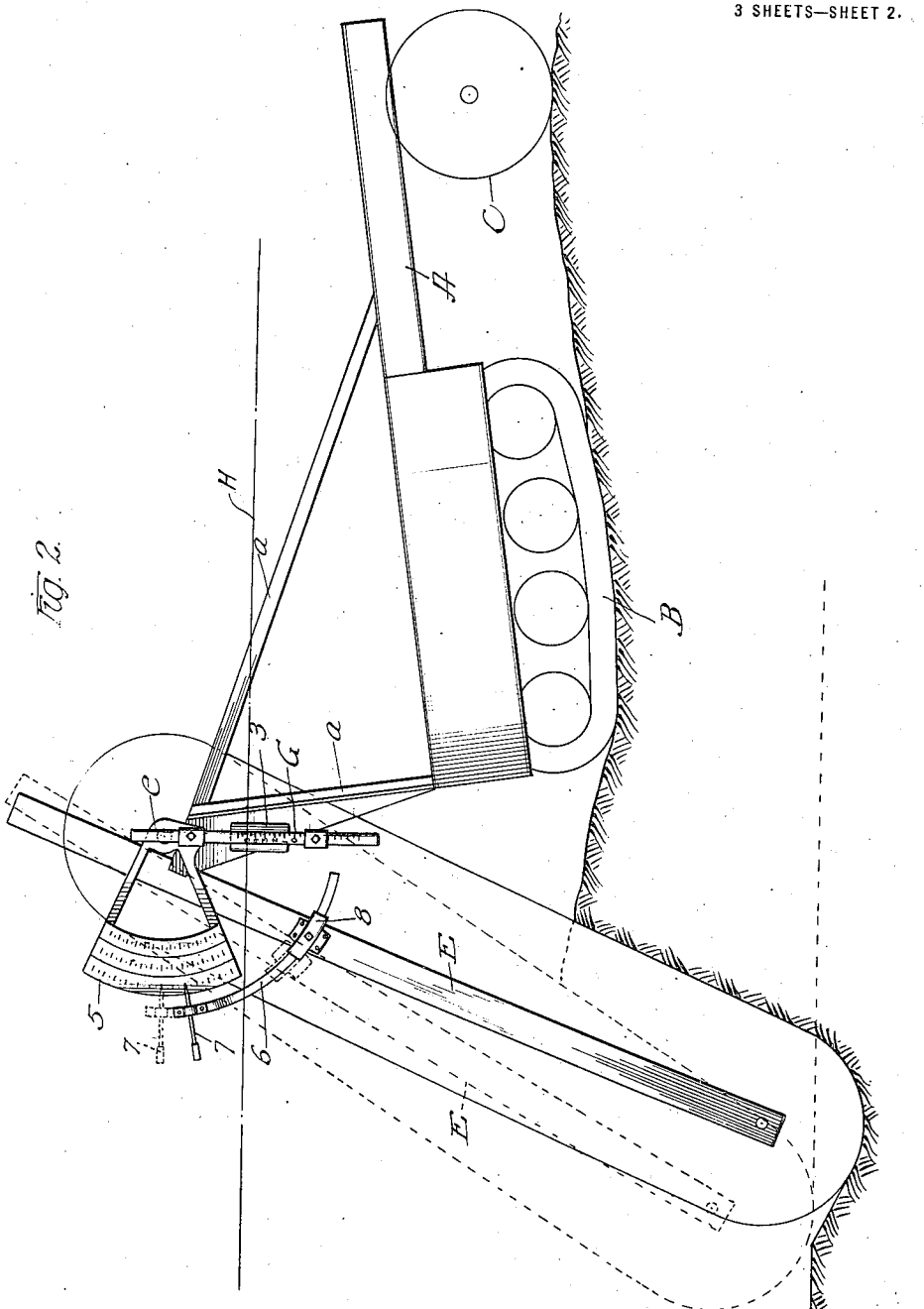


Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

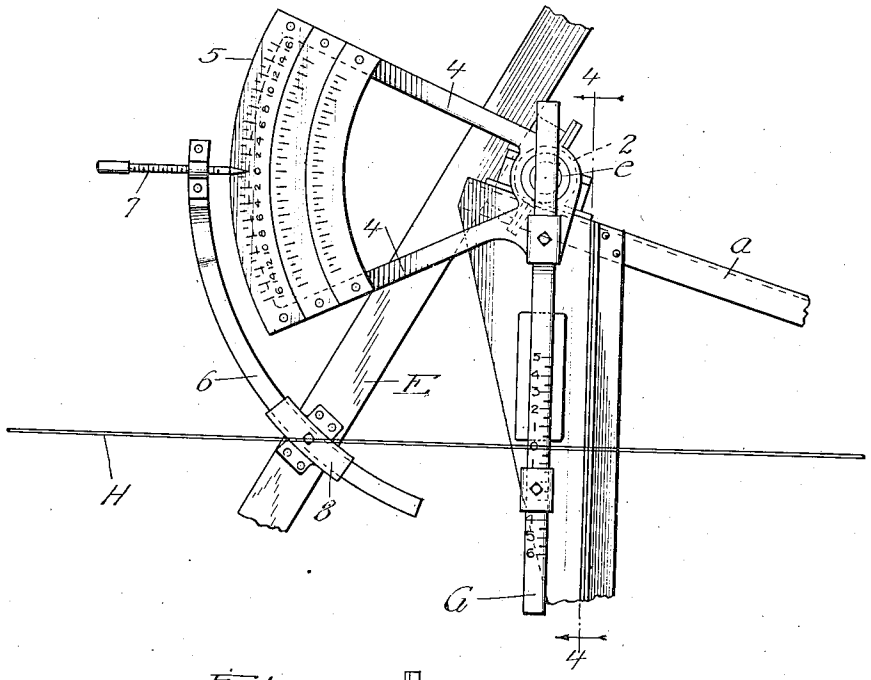
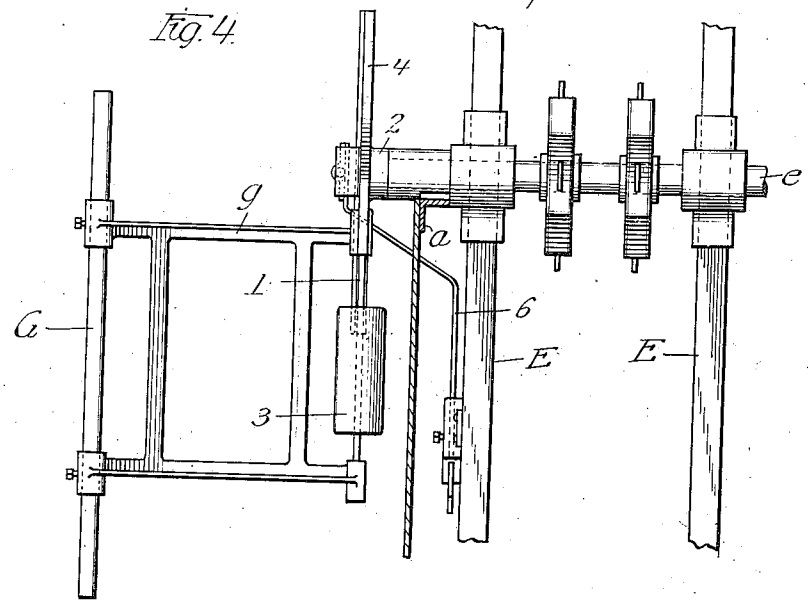


Fig. 4.



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UNITED STATES PATENT OFFICE.

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GRADE-LINE INDICATOR.

1,300,371. Specification of Letters Patent. Patented Apr. 15, 1919.

Application filed September 24, 1917. Serial No. 192,895.

To all whom it may concern:

Be it known that I, JAMES C. FRENCH, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Grade-Line Indicators, of which the following is a specification.

My invention relates to grading devices for excavators in general, but more particularly to those employed on trenching machines to preserve the grade line of the bottom of the trench, while the machine is passing over hilly or uneven ground, and whereby the digging device at the rear of the trenching machine may be adjusted in accordance with the rise and fall or changes in position of the body of the excavator, thereby to keep the bottom of the trench level.

Generally stated, the object of my invention is to provide a novel and improved excavator grading device or grade line indicator which will automatically indicate at all times the adjustment of the digging device necessary to maintain the predetermined grade line for the bottom of the trench.

It is also an object to provide certain details and features of construction and combinations tending to increase the general efficiency and desirability of a grading device of this particular character.

To these and other useful ends, my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings:

Figure 1 is a side elevation of a trenching machine provided with a grading device or grade line indicator embodying the principles of my invention.

Fig. 2 is a diagrammatic view of said excavator and grading device, in side elevation, illustrating the method of operation thereof;

Fig. 3 is an enlarged side elevation of said grading device.

Fig. 4 is a detail section on line 4—4 in Fig. 3.

As thus illustrated, my invention comprises a suitable body frame A mounted on caterpillar traction devices B and front wheels C, of any suitable character, and provided with an engine or motor D to operate said traction devices to propel the machine forward, and to run the excavating apparatus. Said apparatus comprises a digging beam E mounted on a transverse shaft *e*, which latter is supported on a suitable frame *a* at the rear of the excavator body. An endless series of buckets F mounted on sprocket chains *f* is suitably mounted on said digging beam and arranged to cut a trench by their upward movement as the machine moves slowly forward in the usual and well known manner. The power transmitting connections between the engine and the digging apparatus may be of any suitable or desired character. In a machine of this kind, of course, the desired grade line for the bottom of the trench will be maintained while the machine is traveling horizontally on level ground. However, should the front end of the machine suddenly tilt upward, the result would be a depression of the digging and conveying buckets at the rear end of the machine, with the result that the bottom of the trench will be depressed away from the desired level or grade line thereof. Also, should the front end of the machine suddenly drop downward, the digging buckets at the rear of the machine will rise, and this will bring the bottom of the ditch upward to a point higher than the level desired therefor. In the operation of a machine of this kind, therefore, it is the practice to change the angle of the digging beam E to meet the requirements, as the body of the machine tilts upward or downward at the forward end thereof, various arrangements having been provided for assisting in such adjustment. With the arrangements heretofore arranged for this purpose, however, it is not always possible to accurately adjust the digging apparatus, in a satisfactory manner. In some cases it has been difficult or practically impossible to maintain the bottom of the ditch level or straight while the machine was passing over uneven surfaces of the ground. With a view, therefore, to enabling the operator or attendant to know at a glance, at all times, whether the digging apparatus requires readjustment to bring the lower end thereof back onto the grade line from the bottom of the trench, a vertical and graduated indicating bar G is hung on the shaft *e*, through the medium of a laterally projecting frame *g* mounted on a pendulum 1 which has a bearing 2 by which it is swingingly supported on said shaft, the pendulum weight 3 serving to

keep this entire swinging structure in a vertical position. The upper portion of the pendulum 1 is provided with a rearwardly extending frame 4 which carries a graduated segment 5, the graduations on this segment corresponding to the degrees or graduations on the vertical bar G in the manner shown. The zero mark is at the center of the series of graduations, in each case, and the graduations are numbered therefrom in opposite directions. The digging beam E is provided with an adjustable curved bar 6, having a pointer 7 that travels on the circle of the graduations of the indicator 5, in a manner that will be readily understood. The bar 6, of course, is curved about the axis of the shaft *e*, and is mounted in a bracket 8 on the beam E, so that the pointer 7 is adjustable on a circle struck from said axis.

The operation is as follows: The grade wire H is strung on poles or posts above the ground, in the direction desired for the trench, the depth of the trench below this grade line having been previously determined. The machine is started so that the line H is opposite zero on the indicator G, (see Fig. 3) and with the beam E adjusted by the device I (which may be of any known character) so that the pointer 7 is at zero on the indicator 5, when the digging apparatus is at the desired depth for the trench. The machine then moves forward, with the buckets F operating in the customary manner. So long as the machine travels horizontally over level ground no adjustment of the digging apparatus will be necessary. Suppose, however, that the front end of the machine tilts upward, as shown in Fig. 2, which would depress the lower end of the digging apparatus, and which would bring the bottom of the ditch or trench below the predetermined grade line therefor. In such case, the backward tilting of the frame *a* on which the shaft *e* is mounted would depress the latter, causing the zero mark on the indicator G to fall below the wire or grade line H, and causing the zero mark on the indicator 5 to rise above the pointer 7, in a manner that will be readily understood, for the pendulum weight 3 keeps the indicator G vertical and maintains the correct position for the indicator 5 regardless of the position of the body of the excavator. The operator or attendant, observing that the grade line is not being maintained, will then operate the adjusting device I of the digging apparatus, which device is of any suitable or well known character, as, for example, like those commonly used in trenching machines of this class, so that the lower end of the beam E will be tilted upward until the pointer 7 is again opposite the zero mark on the indicator 5, as shown in dotted lines in Fig. 2, which brings the lower end of the digging apparatus into position to maintain the desired level of grade line for the bottom of the trench. Should the body of the excavator tilt in the opposite direction, thus raising the shaft *e*, the beam E will thereby be tilted upward, and adjustment of the device I will be necessary to tilt the beam downward again, the amount of adjustment necessary for this purpose being determined by an inspection of the indicators G and 5 in a manner that will be readily understood. Sometimes, of course, in order to maintain the desired depth for the bottom of the trench, the pointer 7 must be raised or lowered relative to the zero mark on indicator 5, depending upon the number of degrees which the zero mark on indicator G is found to be either below or above the wire H, which will be true in cases where the body of the machine, while traveling along, rises and falls and is found to be working at different heights relative to the wire H, but in a horizontal position. In other words, the body of the machine may be found to be working either higher or lower, but in a horizontal position, and with the pointer 7 opposite the zero mark on the indicator 5, but with the zero mark on the indicator G either above or below the grade wire H, and in such cases the beam E must be tilted until the pointer 7 is off center, so to speak, a number of degrees corresponding to the number of degrees that the wire H is off center (off the zero mark) on the indicator G, depending upon the condition or character of the ground over which the machine travels.

Trenching machines of this type are commonly provided with means for lengthening and shortening the digging beam E, for trenches of different depths, and for this purpose the frame 4 can be provided with a plurality of curved graduated plates, formed on circles of different diameters, as shown in Fig. 3, and the pointer 7 can be made adjustable to enable it to coöperate with any of said graduated plates, depending upon the length of the digging beam.

Also, for the purpose of varying the depth of the trench, the curved bar 6 is adjustable in the bracket 8, so that the digging device can be set for any desired depth when the machine starts a trench. If the digging beam is raised, and the pointer 7 then brought back to zero, a trench of less depth will then be made. On the other hand, if the digging beam is lowered and the pointer 7 then brought back to zero on the indicator 5, a trench of greater depth will then be made as the machine moves forward.

While the wire H is shown as the means for forming the grade line above ground, it is obvious that any suitable means can be employed for this purpose, which will form either a continuous and tangible line, or which

will form or determine an imaginary grade line, as, for example, by a series of posts arranged so that the operator or attendant can sight from one post to another, along the line of posts, and thus determine whether the zero mark of the indicator G is on the line.

The invention is not limited to the exact construction shown and described.

What I claim as my invention is:

1. In a trenching machine provided with a digging device mounted to swing about a horizontal axis extending transversely of the trench, means above the ground to form a grade line, an indicator on the machine to coöperate with said grade line to indicate the rise and fall of said axis when the machine travels over uneven ground, and means operated by pendulum action about a horizontal axis to determine the adjustment necessary for said digging device about said axis to maintain the lower end thereof the desired distance below said grade line.

2. A structure as specified in claim 1, said indicator comprising a vertically graduated member hung from said axis to swing pendulum-like thereon, and said means comprising one element having graduations on a curve struck from said axis and another element mounted to coöperate therewith, one of said elements being rigid with said graduated member and the other being controlled by said digging device.

3. A structure as specified in claim 1, said indicator comprising a member mounted to swing pendulum-like on said axis, and said means comprising an indicating element mounted to swing about said axis and controlled by said member.

4. A structure as specified in claim 1, said indicator comprising a vertically graduated member mounted to swing pendulum-like about said axis, so that said member will remain vertical when the machine tilts upward or downward at the forward end thereof.

5. The combination of (1) a trenching machine provided with a trench-cutter at the rear end thereof, (2) means for adjusting said trench-cutter about a horizontal and transversely extending axis, to raise and lower the trench-cutter in the trench, (3) means at the side of the trench to form a grade line by which to determine and maintain the desired depth of the trench, (4) means to propel the machine forward while said trench-cutter is in operation, (5) means coöperating with said grade line to indicate the rise and fall of the machine relative thereto, while the machine is traveling over the surface of the ground in a direction parallel with said grade line, and (6) means operating about said axis to determine the adjustment of said trench-cutter necessary to maintain the lower end thereof the desired distance below said grade line.

6. In a trenching machine, the combination of an indicator to show the extent of up and down movement of the machine, a trench-cutter, means for adjusting said trench-cutter, and means oscillatory in a vertical longitudinal plane about a horizontal axis to determine the extent of adjustment necessary for said trench-cutter to maintain the lower end thereof at the desired depth in the ground.

7. In a trenching machine, the combination of a body provided with means to travel over the surface of the ground, a digging device to cut a trench while said body moves forward over the ground, means for changing the depth of said trench-cutter in the ground, and freely swinging devices arranged to swing in a vertical longitudinal plane about a transverse axis and coöperating to indicate the extent of rise and fall of said body and to determine the extent of adjustment necessary for said trench-cutter to maintain the lower end thereof at the desired depth in the ground.

8. In an adjustable trenching machine, the combination of graduated means to indicate the exact degree of rise and fall of the machine, and devices arranged to swing in a vertical longitudinal plane about a transverse axis and coöperating with said means, and operative by pendulum action about a horizontal axis to determine from time to time the exact degree of adjustment necessary to maintain the desired depth of the trench.

Signed by me at Chicago, Cook county, Illinois, this 10th day of September, 1917.

JAMES C. FRENCH.