Jan. 20, 1959 J. T. HAZAK 2,869,824

AUTOMATIC DROP WEIGHT FOR BORING

Filed March 26, 1957 2 Sheets-Sheet 1

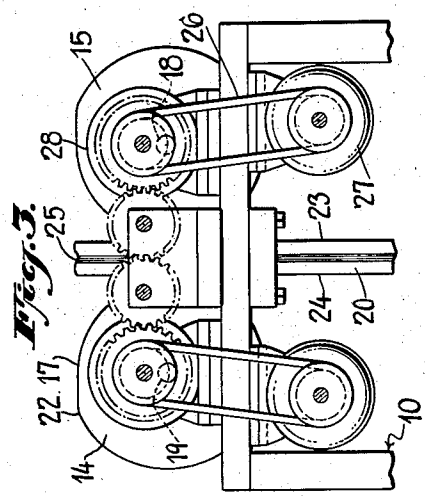


Fig. 3.

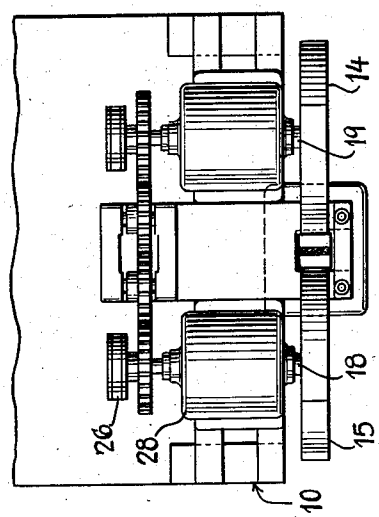


Fig. 4.

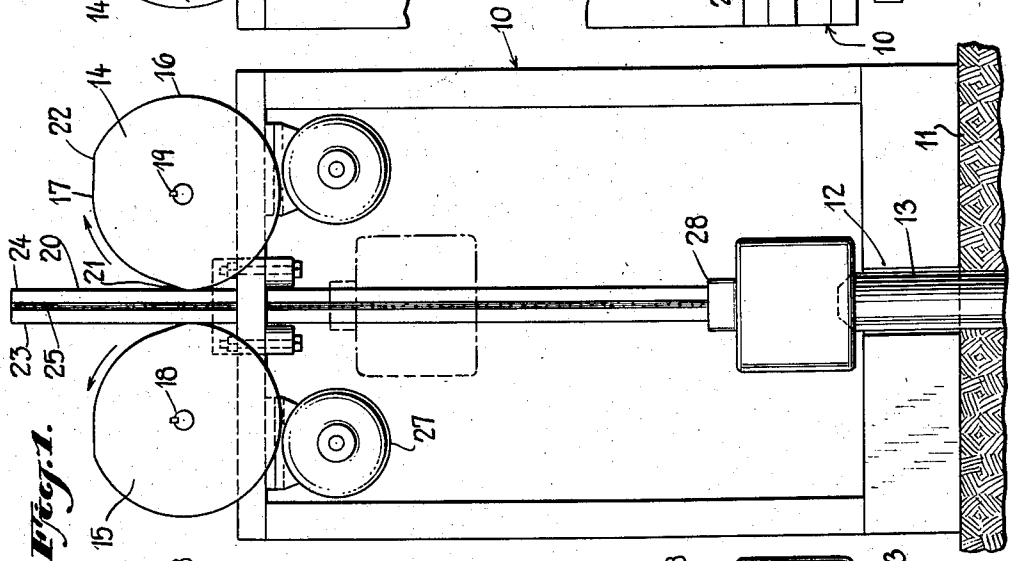


Fig. 1.

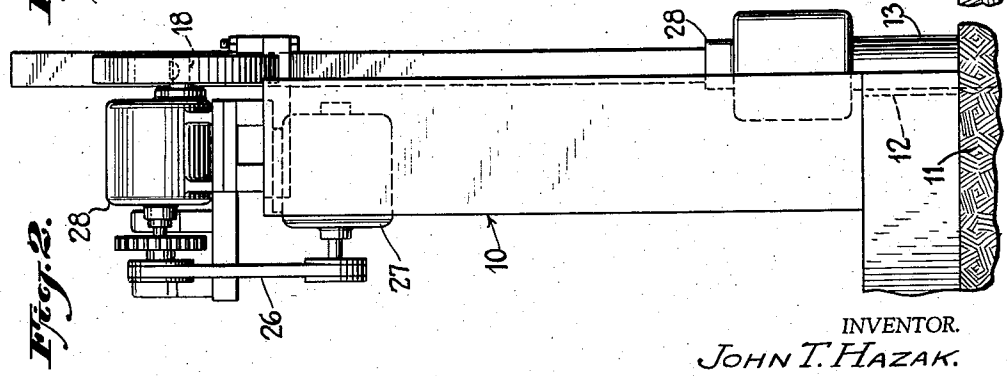


Fig. 2.

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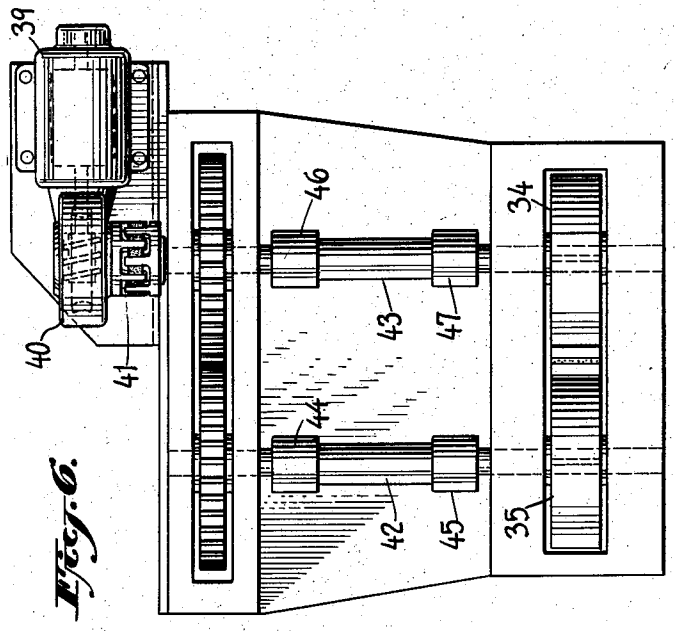


Fig. 6.

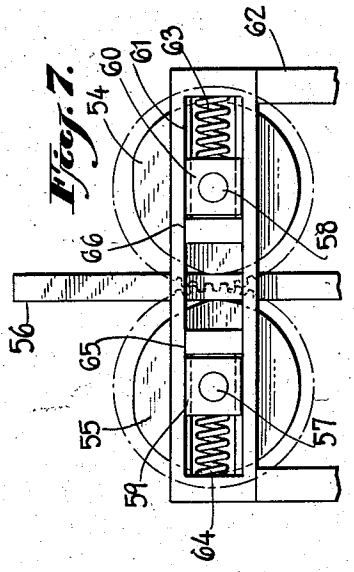


Fig. 7.

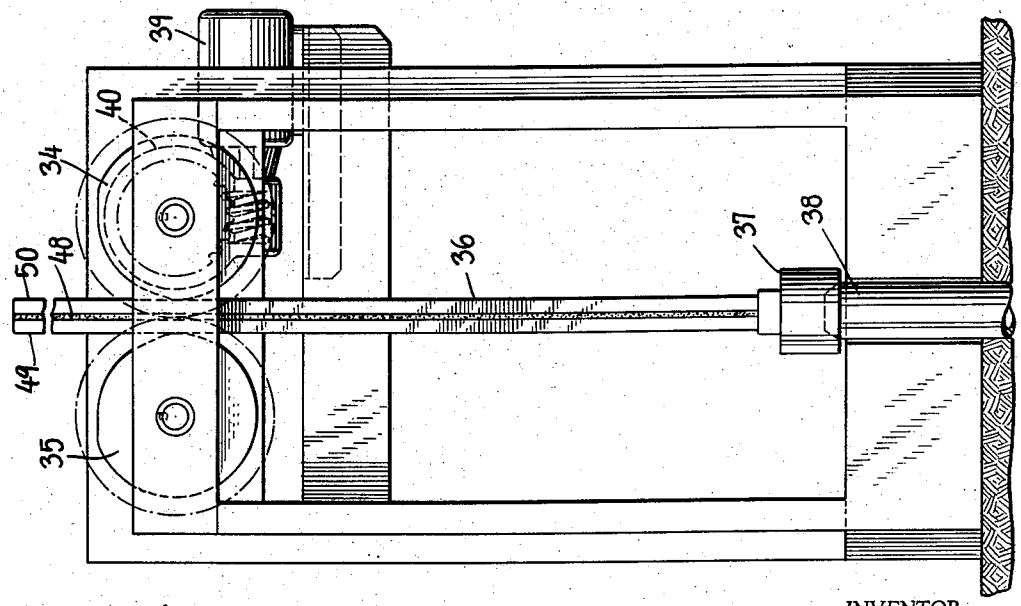


Fig. 5.

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AUTOMATIC DROP WEIGHT FOR BORING

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Application March 26, 1957, Serial No. 648,675

1 Claim. (Cl. 255—1)

This invention relates to an improved drop weight mechanism for test borings and more particularly such type apparatus wherein the operation of the drop weight is fully automatic and precision calibrated.

It is common practice in the exploration of a ground site for future construction to drive a boring rod into the soil in order to determine the soil bearing capacity at various penetration depths and also to obtain samples of the types of soil which the contemplated construction will encounter. Heretofore it has been the practice in making such test borings simply to lift a weight by means of a rope attached thereto, with the rope running up through a pulley and then down to a revolving drum. The operation is by hand with the operator tightening the rope around the drum when it is desired to lift the weight. Revolution of the drum will take up on the rope and cause the weight to be lifted to the desired distance above the boring rod which is to be driven into the ground. When the weight is so lifted to the desired distance, the operator simply slips the loops of rope on the revolving barrel, thereby causing the weight to drop and drive the rod a distance into the soil.

When the foot pounds of energy delivered to such a boring rod are precisely known and the distance the rod is driven into the soil by that energy is measured, many formulas exist which enable the engineer to determine from this data the soil bearing capacity at the particular ground site. The energy delivered to the rod is of course a function of the size of the drop weight and the distance through which it is dropped. By predesign the size of the drop weight may be a carefully calibrated known value, and conventional practice calls for this weight to be dropped a distance of thirty inches on each blow so as to insure uniform and known energy impact per blow. However, in the above-described hand operation presently being used, the operator simply judges this thirty inches by eye and when the weight has reached that height, he slips the rope on the revolving drum, thereby permitting the weight to drop onto the top of the rod. Quite obviously, it is inherently impossible for any operator to so slip the rope at completely or precisely the same elevation of the weight relative to the top of the rod on every blow. This is especially true, since with each successive blow the rod will be driven a distance into the ground, thereby changing the elevation level of the top of the rod. Thus the energy delivered to the rod will vary from blow to blow, and the subsequent calculation of the soil bearing capacity by the engineer will be inherently subject to errors which may be larger or small, depending upon the degree of accuracy of the operator's visual judgment and manual dexterity.

The present invention overcomes these and other disadvantages of the prior art by providing an apparatus which is automatic in operation and hence not subject to the errors inherent in human judgment and manipulation and which, moreover, is provided with carefully calibrated means designed to insure that the drop weight

will travel for each blow a uniform predetermined distance relative to the top of the boring rod regardless of how far that rod has been driven into the ground by preceding blows. The invention comprises a pair of oppositely rotating lift sheaves mounted on a guide frame or stand, adapted to be positioned at the boring site and having a boring rod guide bore therein which is adapted to slidingly receive the boring rod which is to be driven into the ground. The axes of rotation of the sheaves are disposed in parallel relationship and are so spaced apart that the opposed peripheries of the respective sheaves are adapted to receive therebetween a longitudinally extending lift-rod to the lower end of which is secured a conventional drop weight. The peripheries of each of the sheaves are provided with arcuate raised portions, each the same length, said length being equal to the distance which it is desired to raise the lift-rod and drop weight. Drive means are provided for continuously rotating the lift sheaves in opposite directions with the spacing between sheaves relative to the thickness of the lift-rod being such that, when the raised portions thereof come into contact with the rod, the same will be frictionally gripped and lifted above the top of the boring rod. When the sheaves have been rotated to the point where the raised portions of their peripheries end, the lift-rod will be released and permitted to fall under the force of gravity to deliver an impact blow to the boring rod. Means are provided in the drive mechanism for absorbing the shocks which will be encountered on each cycle of the sheaves when their raised portions come into contact with the lift-rod.

Further objects, features and advantages of the invention hereof will appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification and illustrate by way of example preferred embodiments of the invention.

Referring now to the drawings:

Fig. 1 is a front elevational view of one embodiment of an automatic drop weight mechanism of the invention;

Fig. 2 is a side elevational view of the embodiment shown in Fig. 1;

Fig. 3 is a fragmentary rear elevational view of the embodiment of Fig. 1;

Fig. 4 is a fragmentary top plan view of the embodiment of Fig. 1;

Fig. 5 is a front elevational view of another embodiment of the drop weight mechanism of the invention;

Fig. 6 is a top plan view of the embodiment of Fig. 5; and

Fig. 7 is a fragmentary side elevational view showing a modified mounting for the lift sheaves of the embodiment of Fig. 5.

Referring now in more detail to the drawings and particularly Figs. 1–4 thereof, the automatic drop weight mechanism of the invention comprises a guide frame or stand 10 which is adapted to rest as shown on the ground 11 at the particular location where it is desired to make soil bearing capacity tests. Frame 10 is provided with a vertical, boring rod guide bore 12 adapted to slidingly receive a conventional boring rod 13. Mounted on the upper portion of frame 10 are a pair of oppositely rotating lift sheaves 14, 15, each having an arcuate portion of their periphery raised as at 16, and the remaining portion recessed as at 17. As best shown in Fig. 1, these sheaves 14, 15 are mounted on drive shafts 18, 19 arranged in spaced apart relationship. Said drive shafts are so spaced apart and positioned relative to one another that the opposed peripheral portions of the lift sheaves do not come into contact with one another, but are suitably spaced apart so as to receive therebetween a lift-rod 20.

Secured to the lower end of the rod is a conventional drop weight. The lateral spacing between lift sheave peripheries is such that when the raised arcuate portions of the respective sheaves are rotated into contact with the lift-rod as at 21, the same will frictionally grip the rod, and as rotation of the sheaves continues, will cause the rod to be elevated above the top of boring rod 13. Elevation of the lift-rod will continue until the sheaves have rotated beyond the extremities of their raised portions, namely, after for example, point 22 on sheave 14 has been rotated past the point of contact with the lift-rod. When this occurs, the lift-rod 20 will be disposed between the recessed portions 17 of the sheaves, which by design are dimensioned so as to avoid contact with the rod and thus the rod and its attached drop weight will be permitted to fall by gravity and deliver an impact blow to the top of the boring rod.

It will be of course understood that the distance which the lift-rod is raised for each rotation of the lift sheaves will be dependent upon the arcuate length of the raised peripheral portions of those sheaves. Thus by carefully calibrating the lift sheaves to have raised portions of, for example, 30 inches in arcuate length, the mechanism will be designed to automatically raise the lift-rod a distance of 30 inches above the top of the boring rod for each rotation of the sheaves. This 30-inch lift will be accomplished irrespective of the distance the boring rod has been driven into the ground on each preceding blow.

In order to insure a good frictional grip between the opposed lift sheaves and the surface of the rod, the contacting portions may be formed of materials having a high co-efficient of friction; for example, it has been found highly desirable to form the lift sheaves of aluminum and the lift-rod also of aluminum, which provides an excellent co-efficient of friction. In order to enhance the frictional grip between the sheaves and rod, the latter may be constructed of the sandwich type having a pair of plates 23, 24 between which is suitably secured a resilient strip or sandwich 25, which may be formed of rubber or similar material. When such a sandwich design lift-rod is used, the drive shafts 18, 19 are positioned so that when the raised arcuate portions of the lift sheaves come into opposed relationship, they will be spaced apart a distance slightly less than the thickness of the rod which, as shown in Fig. 1, is of uniform thickness throughout its length. Thus when these raised portions are rotated into contact with the rod they will exert pressure against the sides of the rod plates 23, 24 thereby compressing the sandwich 25 and increasing the frictional grip beyond that which would ordinarily be expected according to the co-efficient of friction of the materials in contact with one another.

It will be of course understood that suitable drive means are provided for continuously rotating the sheaves 14 and 15 at a uniform speed. Moreover, it will be understood that such drive mechanism must be designed so as to absorb the shocks which will normally result when the raised peripheral portions of the lift sheaves initially grip and release the lift-rod. In the embodiment shown in Figs. 1–4 such a drive comprises a belt drive 26 from motors 27 through suitable reduction gearing 28 to the shafts 18 and 19 and their sheaves. This belt drive 26 will provide sufficient looseness in the system to absorb any shocks which may normally accrue upon contact of the raised peripheral portions of the sheaves with the lift bar or release therefrom. Furthermore, if desired, a shock absorption mounting 28 may be employed to secure the lower end of the lift-rod 20 to the drop weight. This mounting may, for example, be of the design shown in the pending application S. N. 585,439, filed May 17, 1956, Hazak et al., now Patent No. 2,798,363.

The embodiment of the invention shown in Figs. 5 and 6 is basically similar in operation to the embodiment of Fig. 1 and comprises likewise a pair of oppositely rotating lift sheaves 34, 35 adapted on each cyclic rotation thereof to raise a lift rod 36 and attached drop weight 37 a uniform predetermined distance above the top of a boring rod 38 and release the same for delivering impact blows to the rod. The design of the sheaves and lift-rod is the same as that described above in connection with Fig. 1. However, in this embodiment an alternate form of driving mechanism is provided for absorbing the shocks naturally incumbent in the system when the sheaves engage and release the lift-rod. This driving mechanism comprises a motor reducer 39 which drives through a conventional worm gear assembly 40 and flexible coupling 41 to a pair of flexible coupling drive shafts 42 and 43, which, in turn, impart continuous, uniform rotative speed to the lift sheaves. The drive shafts 42, 43 may be provided with flexible couplings 44, 45, 46 and 47 of a type of conventional design, for example, similar to coupling 41. The function of these flexible couplings is to provide sufficient freedom in the system to absorb shocks normally incumbent with the lift sheaves gripping and releasing the lift-rod at the beginning and end of each lift stroke.

As shown in Fig. 5, lift-rod 36 is also of the sandwich type, as shown in connection with Fig. 1, having a rubber or other resilient strip 48 disposed between a pair of plates 49, 50 to increase the frictional grip between the sheaves and lift-rod. However, in some instances it may be desirable to use a solid rod rather than one of the sandwich type and in such an event the construction of Fig. 7 is a desirable one. There a pair of lift sheaves 54 and 55, having alternately raised and recessed arcuate portions, may be driven as described above. Disposed therebetween is a solid lift-rod 56. The lift sheaves 54 and 55 are mounted on shafts 57 and 58, which, in turn, are mounted in sliding bearing blocks 59, 60. These sliding bearing blocks 59 and 60 are adapted to slide laterally in suitable guide racks such as 61 provided in the supporting frame member 62. Disposed between the bearing blocks and the frame are compression springs 63, 64 which normally urge the bearing blocks and thus their attached lift sheaves toward lift-rod 56, the extent of lateral displacement of these blocks under the urging of the springs being limited by stop blocks 65, 66. These stop blocks 65 and 66 may, if desired, be adjustable, but in any event are positioned so that the recessed portions of the lift sheaves will always when in opposed relationship be spaced apart far enough to provide free passage of the lift-rod therebetween, while the raised portions of the lift sheaves will, when in opposed relationship, be normally spaced apart a distance slightly less than the width of the lift-rod 56. Thus, it will be observed that when the raised portions of the sheaves are rotated into contact with the lift-rod, the entry of the lift-rod therebetween will force these bearing blocks back slightly against the action of springs 53, 64, thereby enhancing the frictional grip between lift sheaves and rod.

It will be of course understood that the raised arcuate portions of the lift sheaves 34, 35 in Fig. 5 and 54, 55 in Fig. 7 will be designed so as to have arcuate lengths of precise extent, for example 30 inches, and thus insure that the drop weight will be lifted this exact predetermined distance on each rotative cycle of the sheaves.

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various further modifications thereof after study of this specification will be apparent to those skilled in the art to which this invention pertains. Reference should accordingly be had to the appended claim to determine the scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

An automatic drop weight mechanism for imparting

successive impact blows to a boring rod to be driven into the ground for test purposes which comprises a pair of spaced apart, rotatably mounted metallic lift sheaves, a lift-rod of uniform thickness throughout its length and having a drop weight secured thereto, said lift-rod being disposed between opposed peripheries of said sheaves, and comprising a pair of longitudinally extending metallic plates with a resilient strip disposed therebetween, means for oppositely rotating said sheaves at a uniform speed, each of said lift sheaves having a raised peripheral portion and a recessed peripheral portion, said raised portions of the sheaves being of predetermined equal length, said length being equal to the distance which it is desired to raise the lift-rod, and said lift sheaves being adapted to grip the lift-rod during that portion of

each rotation when the rod is disposed between their raised peripheral portions, and to release said rod during that portion of each rotation when the rod is disposed between their recessed peripheral portion whereby the drop weight is permitted to drop a predetermined uniform distance to the boring rod for each successive blow, regardless of how far the boring rod has been driven into the ground with the preceding blow.

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