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USE OF A DISTRIBUTED CHARGE IN SEISMIC PROSPECTING

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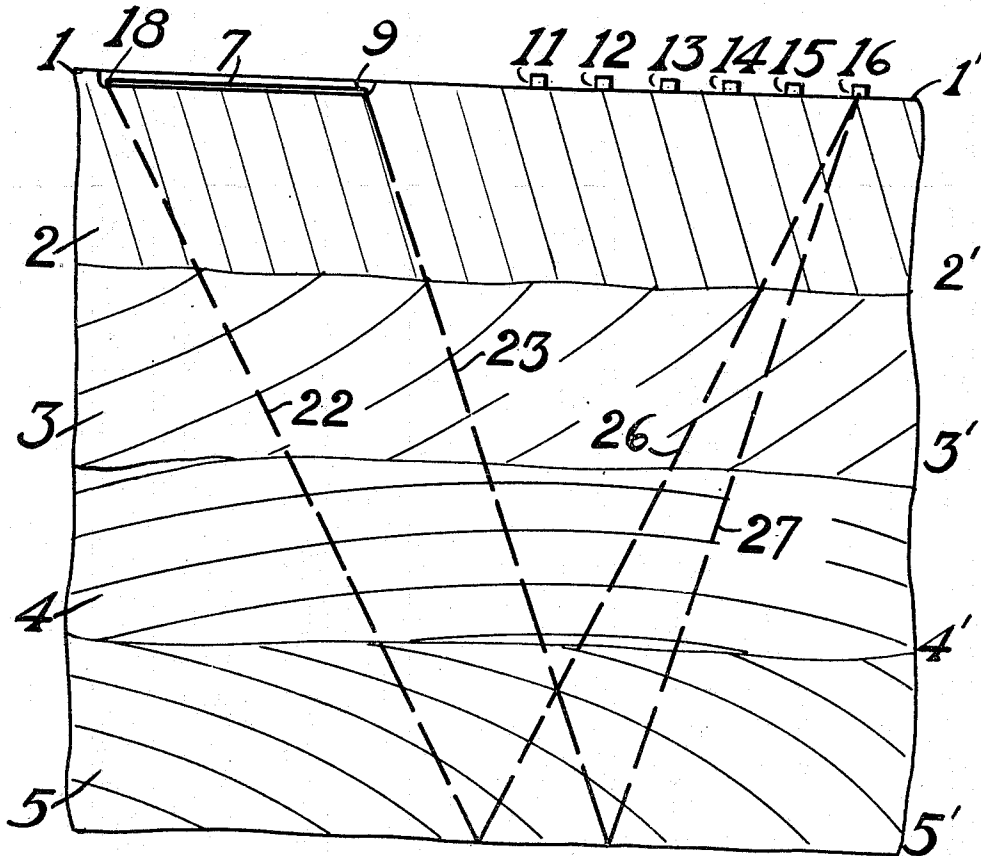


Fig. -1

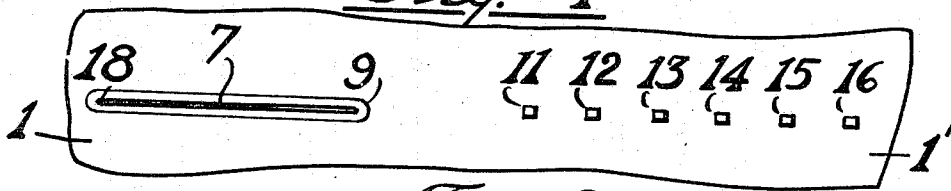


Fig. -2

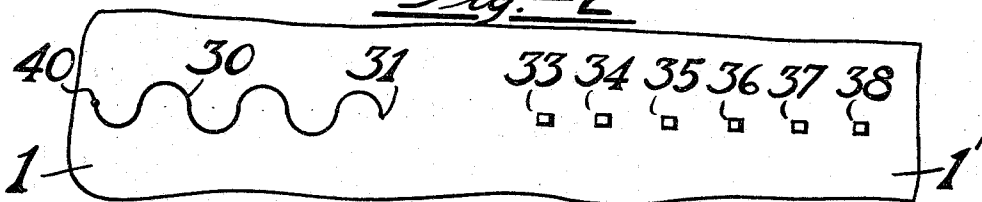


Fig. -3

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USE OF A DISTRIBUTED CHARGE IN SEISMIC PROSPECTING

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3 Claims. (Cl. 181—0.5)

This invention relates to improvements in seismic exploration such as the search for oil or minerals beneath the surface of the earth.

In the previously known method of reflection seismograph geophysical exploration, a charge of explosive has been detonated in a drilled hole at a depth of approximately 30 to 100 feet beneath the surface of the earth. The energy from this explosion has gone downwardly in the form of earth waves which have been reflected from some subsurface formation and have come back more or less vertically to the surface. The reflected waves have been caused to actuate one or more geophones placed on the surface of the ground in spaced relation to the shot point. Some of the energy from the explosion has also travelled through the upper layers of the ground to the geophones and has at times disturbed the geophones so much that the effect of the relatively weak reflected earth waves could not be detected by the geophones.

It is an object of this invention to obtain reflected earth waves of sufficient energy to be recorded from an explosion at the surface of the earth instead of in a drilled hole.

Also, the object of this invention is to provide an improved method of creating explosive energy whereby the surface waves will not obliterate the reflected waves.

Other objects of the invention will be apparent from the specification taken together with the accompanying drawing, in which latter—

Fig. 1 is a vertical sectional view through the ground showing diagrammatically the arrangement of the explosive with respect to the detectors.

Fig. 2 is a top plan view of the structure illustrated in Fig. 1, and

Fig. 3 is a top plan view of a modified arrangement of the explosive.

Referring particularly to Figs. 1 and 2 of the drawing, reference numeral 1—1' designates the surface of the earth. Reference numerals 2—2', 3—3', 4—4' and 5—5' designate the earth strata beneath the surface.

Explosive energy is created at the surface of the earth by means of a long length of fuse 7, which may be known as Cordeau fuse, which is disposed in a substantially straight line at or near the surface of the earth. In the embodiment illustrated, a shallow trench is dug in the earth to a depth of one or two feet and the fuse 7 disposed in the trench. The fuse can then be covered with water, earth, or the like. Alternatively, the fuse 7 can be disposed directly upon the surface of the

ground. The fuse in its preferred embodiment is formed by a tubular lead sheath, the bore of which is filled with a suitable explosive, such as nitroglycerin. It will be understood that other types of elongated explosive can be used and some of the advantages of the invention will be retained. The explosive is preferably used in lengths of from 100 to 300 feet or longer.

Receiving stations are disposed in alignment longitudinally with the length of the fuse and in spaced relation thereto. The receiving stations are nearest the end 9 of the fuse. The receiving stations comprise geophones or seismographs 11 to 16 inclusive. The geophones function to receive and record the energy transmitted through the ground from the shot point in a manner well known to the art.

The explosion is created by detonating the end 18 of the fuse which is farthest from the geophones. The explosion, starting at end 18, travels along the fuse to end 9. The explosion progressively continuously creates explosive energy from 18 to 9 along a continuous line aligned with the receiving stations whereby a wave-front is created which passes downwardly through the earth strata, as indicated by the dotted lines designated 22 and 23. The wave-front strikes the lower surface of the earth immediately beneath the stratum 5—5' and is reflected upwardly, as indicated by the dotted lines 26 and 27 to geophone 16. It will be noted that the impulse from the end of the fuse 9 starts at a later time than the impulse from the end 18 of the fuse but travels to geophone 16 by a shorter path. This is true proportionately of the impulses generated nearest the end 9 with respect to those generated nearest the end 18 of the fuse. Consequently, it will be seen that the impulses created throughout the extent of the fuse reach the geophone 16 simultaneously and mutually reinforce each other.

The horizontal waves generated at successive points between the ends 18 and 9 of the fuse travel toward the geophones 11 to 16 inclusive through the surface stratum 2 at sufficiently spaced intervals to each other so that they are received and recorded by the geophones as independent waves without reinforcing each other. Consequently, the disturbance registered by each geophone, due to horizontal waves, is sufficiently weak to permit of the clear recording of the reflected wave-front which has been caused to actuate the geophone simultaneously. The reflected waves reinforce each other to provide a relatively strong kick to the instrument.

Referring particularly to Fig. 3 of the draw-

ing, a modified arrangement is shown in which a fuse 30 is arranged in a generally serpentine manner, as illustrated, with an end 31 adjoining the receiving stations 33 to 38 inclusive, and an end 40 farthest from the receiving stations. The fuse 30 is disposed substantially in alignment with the receiving stations, as illustrated. Due to the serpentine shape of the fuse 30, a longer time is required for the explosions to travel from the end 40 to the end 31 of the fuse and therefore, by adjustment of the curvature of the fuse, adjustment can be made to permit of the simultaneous arrival of the reflected waves from a stratum to a given geophone. Alternatively, the composition of the fuse can be varied to cause the travel of the explosion along the fuse to be faster or slower, as may be required for a particular area being prospected, to cause the wave-front created by the explosion and reflected from a given stratum to reach the geophone simultaneously. The arrangement described permits of a considerable range of adjustment in order to secure the maximum effect of the reflected waves upon the seismographs or geophones. The spacing of the fuse and the geophones on the surface of the earth can be suitably adjusted. The length of the fuse can be varied and the velocity of travel of the seismic wave indicated at 22-23 and 26-27 can be adjusted. This velocity can be adjusted by selecting the proper explosive or by laying the fuse in a spiral or serpentine manner. These various factors, in actual practice, will be adjusted so as to approach as closely as possible the ideal condition under which the reflected impulses will arrive at any given geophone simultaneously.

By the procedure described, reflections of increased energy are provided which can be more clearly recorded. The energy is created without the necessity of drilling shot holes in which to place the explosive. Furthermore, the deleterious

effects of the longitudinal waves upon the record which obliterate the record of the reflections are eliminated. The ratio of reflected to disturbing energy is increased.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the art as broadly as the prior art permits.

I claim:

1. In seismic prospecting, the steps which comprise progressively creating explosive energy along a continuous line aligned with a receiving station and progressing toward the receiving station whereby a seismic wave-front is created which is progressively reflected from a subterranean earth stratum, and receiving the wave-front at the receiving station.

2. In seismic prospecting, the steps which comprise disposing an elongated charge of explosive upon the ground in alignment longitudinally with a receiving station, detonating the charge at the end farthest from the receiving station whereby the explosion occurs continuously to the other end of the explosive to form a seismic wave-front which is progressively reflected from a subterranean earth stratum, and receiving the wave-front at the receiving station.

3. In seismic prospecting, the steps which comprise disposing an elongated charge of explosive upon the ground in a substantially serpentine shape in alignment longitudinally with a receiving station, detonating the charge at the end farthest from the receiving station whereby the explosion occurs continuously to the other end of the explosive to form a seismic wave-front which is progressively reflected from a subterranean earth stratum, and receiving the wave-front at the receiving station.

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