Dec. 6, 1949 W. W. MOUNT 2,490,378

SINGLE CABLE ADVANCING MECHANISM AND METHOD

Filed June 29, 1944 2 Sheets-Sheet 1

Fig. 1

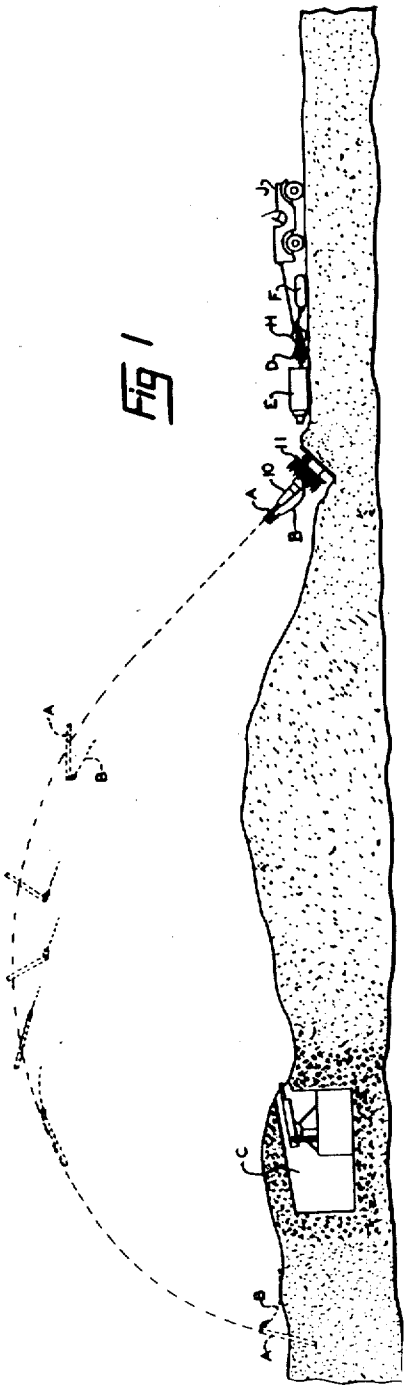


Fig. 2

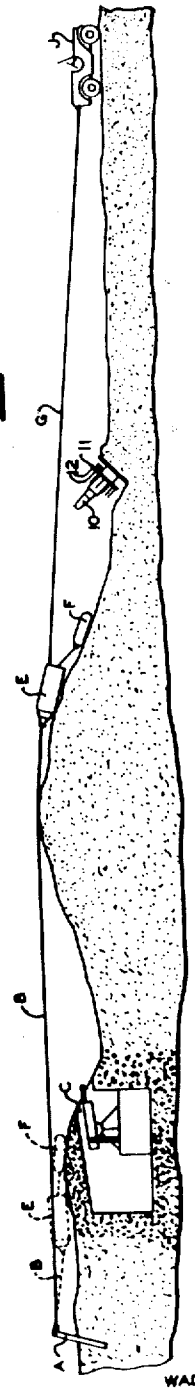


Fig. 9

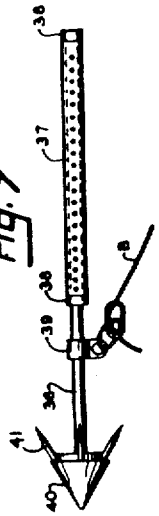


Fig. 8



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SINGLE CABLE ADVANCING MECHANISM AND METHOD

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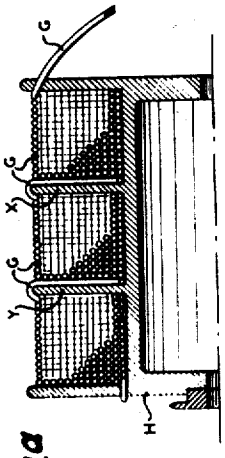


Fig. 4a

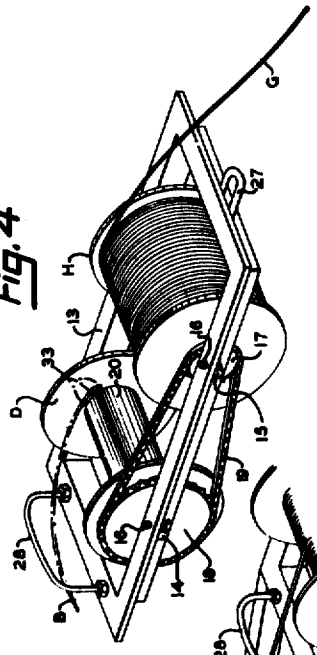


Fig. 4

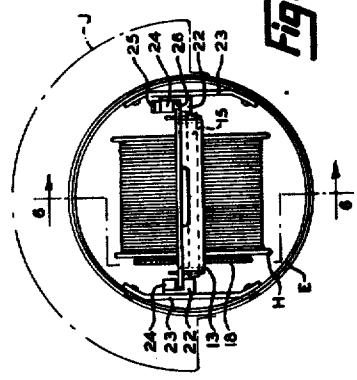


Fig. 5

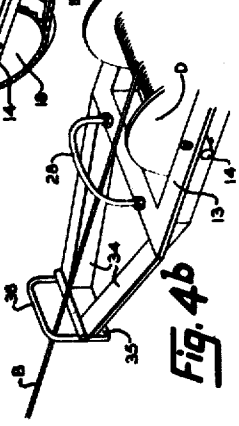


Fig. 4b

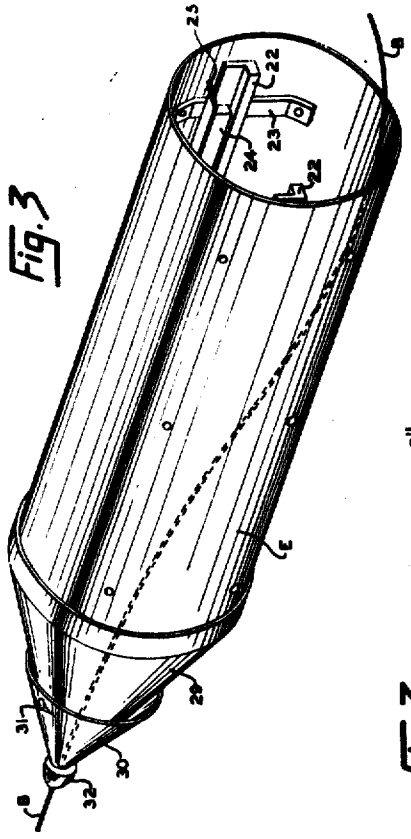


Fig. 3

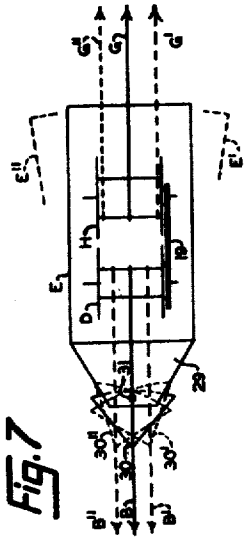


Fig. 7

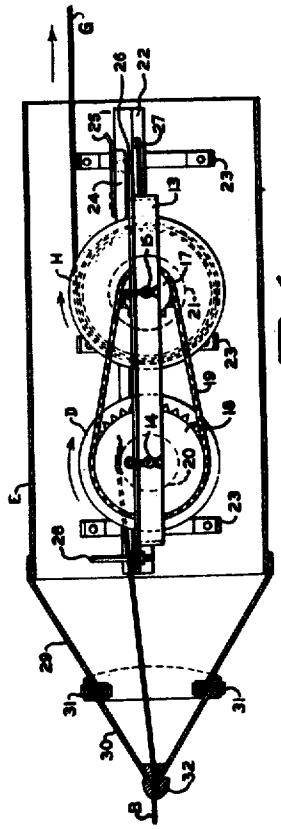


Fig. 6

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UNITED STATES PATENT OFFICE

2,490,378

SINGLE CABLE ADVANCING MECHANISM AND METHOD

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Application June 29, 1944, Serial No. 542,741

31 Claims. (Cl. 254—135)

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The invention relates to a new and useful method and apparatus for accomplishing the movement of objects over land or water under conditions heretofore either prohibitive entirely or so formidable as to defy successful solution through the application of ways and means thus far devised.

In its present preferred embodiments and applications the invention is most useful and applicable in military operations but it will be understood that the principles thereof are also of value and importance in many other fields. In its military application, the invention is directed broadly to the objectives of reducing loss of life and material by enabling objects to be moved from a base station to a point substantially in advance thereof without requiring prior or concurrent movement of personnel therebetween, and in moving objects over areas in emergency and other situations where it is either unsafe or unfeasible to maneuver.

More specifically stated, objects of the invention comprise the provision of the novel method and combination of means herein disclosed for advancing objects unattended by personnel in military or other fields; for enabling maneuverability of personnel and equipment with safety, dispatch and assurance in water, mountain and jungle areas and in campaign and tactical operations, in spite of enemy inspired defenses or of natural physical hazards in the particular field of application. In warfare, the invention may be usefully employed, for example, to move weapons and other objects varying in size, weight and shape in clearing or marking out a desired path of advance through a mine field, through barbed wire or other enemy obstructions or defenses preparatory to the advance of personnel and equipment. Further, in emergencies or situations where available land or water conveyances cannot operate, through failure or lack of power or otherwise, the invention offers practical means for maneuvering.

Other objects and advantages of the invention will be set forth hereinafter or will be apparent from the detailed description to follow, the novel method and combination of instrumentalities disclosed being pointed out in the appended claims.

The accompanying drawings illustrate one embodiment of the invention and together with the description serve to clarify the application of the apparatus and principles of the invention to the accomplishment of the purposes outlined.

In the drawings:

Fig. 1 is a diagrammatic elevation in miniature depicting the relative disposition and action, in part, of apparatus in connection with an operation for destroying an enemy defense position preparatory to an offensive movement toward such position.

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Fig. 2 is similar to Fig. 1 and depicts the apparatus as disposed in a subsequent stage of action.

Fig. 3 is a perspective view of the outer casing of the advanceable carriage of the invention.

Fig. 4 is a perspective view of the differential reel frame assembly which provides the motive means for effecting advancing movement.

Fig. 4^a is a fragmentary longitudinal section through a modified form of power cable reel provided by the invention.

Fig. 4^b is a fragmentary perspective view of a modified form of the forward end of the reel frame in Fig. 4.

Fig. 5 is an end elevation from the rear or open end of the assembled reel frame and casing of Figs. 3 and 4.

Fig. 6 is a section taken generally on the line 6—6 of Fig. 5.

Fig. 7 is a diagrammatic plan view on a reduced scale of the carriage in Fig. 6 showing the actions of the pivoted cable guiding nose on the carriage.

Fig. 8 shows a projectile adapted to reverse end-for-end during flight and to provide an anchor for a cable drawn by it by embedding itself upon impact with the ground.

Fig. 9 shows a projectile having a heavy barbed nose adapted to provide an anchor for a cable drawn by it by snagging with such objects encountered upon landing or retrograde pull on the cable.

The method according to the invention may be outlined broadly as involving as a first step, projecting from a base station toward the desired point of advance a line of cable, anchoring the distant end of the projected line against retrograde movement, anchoring the home or base station end of the line to take-up reel mounted on an advanceable carriage, unwinding a second line of cable from a power reel also mounted on the carriage, and advancing the carriage and any object to be advanced by it by driving the take-up reel from the power reel to effect winding of the projected cable onto the take-up reel.

In the practice of this method in military operations involving the clearing or marking out of a desired path of advance through a mine field, barbed wire or other enemy obstructions or defenses preparatory to the advance of personnel or equipment, the tactical approach would be to project the line of cable toward the point

of advance by firing a projectile from a gun or by means of a rocket, the projectile having one end of the cable attached to it and being of such construction as to be self-anchoring upon impact or entanglement with such object as it might encounter. However, the invention may be usefully employed in many other kinds of operations, military or otherwise where it may be possible and even desirable for personnel to project the cable by laying it out from the base station rather than by firing a projectile.

Taking up first such operations as the clearing of a path of advance into enemy territory unsafe for the immediate advance of personnel or equipment, the method according to the invention would then involve the actions and apparatus diagrammatically portrayed in Figs. 1 and 2. First, the firing of a self anchoring projectile A to project the cable B toward the suspected locale of a pillbox C, for example; then hitching the base station end of the projected cable to the take-up reel D on a reel frame at the base station, sliding and securing the reel frame within the carriage casing E, unwinding the power cable G from another reel H on the reel frame (manually or by the pull of a suitable vehicle as shown), and utilizing the rotation imparted by unwinding the power cable to drive the take-up reel and advance the carriage and a drag such as an explosive charge F toward the pillbox C as the projected and anchored line of cable B simultaneously winds onto the take-up reel.

For clearing a proposed path of advance through a mine field a barbed or other obvious form of drag suitable for setting off the mines might be employed. And for opening up a barbed wire barrier or the like the carriage might drag or even house within its casing some obvious form of explosive charge, the carriage being capable of advance over barbed wire or other barriers over which the projected cable may be stretched. For destroying a rampart or building, a projectile of the type illustrated in Fig. 9 might be employed, such projectile being adapted to provide an anchor for the projected cable by snagging itself in openings or on projections, thus to enable the carriage and a drag of destructive character to be advanced against the rampart.

Among various applications of the invention to useful purposes which may or may not require the firing of a projectile to project a cable to an advance point are such operations as moving over difficult terrain or ravines. In moving objects over a ravine it may, of course, be desirable in some instances to first fire a projectile to anchor a light cable by which to convey the carriage or personnel or both with a heavier cable as a drag (if indeed a heavier cable is needed), the heavier cable then being suitably anchored on the other side to permit the transport of heavy objects. Another useful application which may or may not involve the firing of a projectile is the towing over water of objects or personnel on rafts or boats in invasion or water-borne operations, the advanceable carriage of the invention being fully capable of movement along the taut cables when submerged. And if desired, a buoyant compartment may be applied to the carriage to enable it to float while being advanced. In another application the differential reel frame unit disclosed may be used without its casing, if desired, to provide a useful form of motive power for moving a floating conveyance or a

land vehicle along the projected and anchored cable, the frame being rigidly mounted on the float or vehicle.

For advancing in mountain or cliff country, equipment hitched to the carriage or contained within the casing may be readily moved in successive stages from one point to another, the method outlined being repeated as many times as required. In such applications the step of projecting a cable might be carried out manually, if this be found feasible, personnel going forward with a spare reel or coil of cable, unwinding it as they progress and suitably anchoring its advance end. With the base station end hitched to the take-up reel, unwinding of the power cable from its reel will advance the carriage until the stretch of laid cable is wound onto the take-up reel. At this point, personnel might again go forward, pulling the cable off the take-up reel as they go and rewinding the power cable onto its reel by the simultaneous backward drive transmitted to said reel, the carriage and its drag meanwhile remaining at the last advanced station. Then, by again unwinding the power cable the carriage and its drag may be further advanced to the extent of the stretch of cable laid out.

Assuming an operation involves the elevation of equipment in cliff country, the carriage and its drag may be advanced while suspended in space on the projected cable. And if such operation should require successive stages of advance the power may be applied entirely from the original base station, it being apparent that after the first stage of elevation of the carriage (and before the power cable is completely rewound onto its reel by the reverse drive imparted thereto as the projected cable taken up in the first stage is unwound from its reel to project it to the next level) a new length of cable may be added to the end of the power cable at the base station so that such cable will be long enough to be tugged on at the base station to effect the next stage of elevation of the carriage.

All of the foregoing operations and indeed many others which will be apparent may be accomplished by the method and means herein disclosed. Considering military operations in particular, the outstanding practical advantages are the saving of lives and equipment, the ability to maneuver and advance more rapidly and with assurance and safety heretofore impracticable if not impossible, and economy and simplicity of the apparatus and its manipulation. It may also be pointed out that in many types of operations much of the cable employed may be reclaimed and that the carriage itself is useable over and over except in instances of its destruction as by direct explosion. Also of importance is the element of surprise, the fact being that apart from the sound upon firing of the projectile in operations of the latter nature, the enemy has little opportunity to observe or determine upon what is occurring, the hurtling projectile and drawn cable being difficult to follow in flight and invisible at night, the carriage being relatively small and reasonably camouflaged, and its relatively slow crawling and wagging motion presenting a mysterious spectacle even if observed.

As will become evident, apparatus of the nature and general construction herein shown and shortly to be described in detail is essential to the execution and fulfillment of the various applications of the foregoing method. Thus in military operations for preparing a safe path for the ad-

vance of personnel and equipment into enemy defended territory, it is essential to the step of advancing the carriage and its drag without exposure of personnel that the projectile fired be self-anchoring and that the line of cable drawn by it be strong and durable, that is, possess the qualities of a flexible steel cable which will not tear or break or be readily severed as would a stretch of rope, for example. In this connection it may be pointed out that experience alone is clear evidence of the fundamental distinction between projecting by gunfire such desirably strong line as a steel cable and effecting its anchorage unattended, and the admittedly old practice of projecting through gunfire an ordinary rope or life-line which, in the many varied forms proposed has proven entirely inadequate in the environments and for the purposes herein discussed.

Also, the general form of the advanceable carriage, the general form and relative arrangement of the parts of the differential cable reel unit, and the means for controlling the feeding and winding of the projected cable onto its reel, all as herein disclosed are important to the successful carrying out of the invention.

Referring now to the drawings, the means for projecting the line of cable by gunfire from a base station to a desired advance point may comprise either a mortar or a rocket type of gun either of which may be adapted, as herein shown, to carry concentric with its tube or barrel a reel of the cable to be projected. This reel is preferably rotatable and the cable is wound thereon according to a novel technique which has successfully overcome the heretofore unsolved problem of projecting steel cable as distinguished from rope. The winding technique employed is disclosed in my pending application Serial No. 476,165 filed February 17, 1943, now Patent No. 2,399,136 dated April 23, 1946, to which reference may be had for details beyond those deemed sufficient to mention at this time. Suffice it to say that as explained in said application, the gun, herein designated generally by the numeral 10, is adapted to support concentric with its barrel a reel 11 arranged for rotation on a suitable bearing such as a shoulder formed on the gun barrel. The reel 11 comprises a base carrying a series of pins 12 secured upright therein and arranged in spaced concentric rows, the cable B being wound in a continuous stretch over the successive concentric rows of pins, preferably from the innermost to the outermost row thereof and essentially from the top to the bottom of each row. The pins 12 are slightly springy or flexible (or even breakable as in the case of wood dowel stock) so as not unduly to resist the unwinding of the cable, but said pins are still rigid enough to produce an effective rotational torque in the reel under the violent pull on the cable when the projectile to which its inner end is securely fastened is fired. The projectile is adapted for insertion into the barrel of the gun which is of course provided with a suitable firing charge. The details of the novel technique necessary to observe in winding the cable B in order that it will unwind without twisting, tearing or snarling when the projectile is fired are fully disclosed in my pending application referred to and repetition here would serve no useful purpose to a clear understanding of the present invention.

At the base station (the right hand portion of an extent of terrain portrayed diagrammatically in Figs. 1 and 2) the gun 10 is installed at a favorable angle calculated to project the cable B

over the range required for the particular objective. As shown, the rotatable reel of cable B to be projected is in place over the gun barrel and the cable is attached to the projectile A to be fired. The take-up reel D and the power cable reel H are carried on a rigid rectangular frame 13, as best seen in Figs. 4 and 6, and preparatory to an offensive operation from the base station this reel frame unit is withdrawn from the advanceable carriage casing E in readiness for hitching the base station end of the projected cable to the take-up reel D.

As shown, the front or take-up reel D and the rear or power reel H are supported on the frame 13 by means of parallel cross shafts 14 and 15, these shafts being held in place and against rotation, for example, by such single, cheap and quickly assembled means as ordinary heavy cotter pins 16 passed through holes in the side members of frame 13 aligned with holes in the opposite ends of the shafts. As here illustrated, the cross shafts 14 and 15 are disposed in a common plane with the fore and aft axis of the casing E but it will be understood that this specific arrangement is neither limiting nor essential to the successful operation, it being evident that disposition of one or both of the reel shafts at the same or differing distances somewhat above or below the axis of the casing would be immaterial.

To one flange of the reel H is secured a sprocket 17 which may be, for example, one-third the diameter of a sprocket 18 secured to the corresponding flange of the take-up reel D. By means of sprockets of this ratio and a chain 19 (or any other suitable power transmitting connection) reel H will drive reel D in a ratio of 3 to 1. From Fig. 6 it will be seen that core 20 of the take-up reel D is somewhat smaller than core 21 of the power reel H. The purpose of this is to provide that the maximum diameter which the cable B may reach as it is taken up on core 20 will not unduly exceed the gradually decreasing and ultimate minimum diameter of the power cable as the unwinding layers of the latter approach core 21, thus to assure always maintaining over the fixed driving ratio a power ratio advantageous to advancing movement of the carriage. It will be understood, of course, that the reels D and H need not be of equal width as shown in the present embodiment, it being obvious that different relative widths would simply give rise to correspondingly differing relative diameters of the windings and cores and that it is only necessary to provide dimensional conditions whereby the ultimate power ratio will amply dominate the driving ratio.

The reel frame 13 may be made of angle iron, as herein indicated, for purposes of economy, strength and ease of sliding onto similar opposed supporting rails 22 secured to several stays 23 fastened as by rivets to the interior of the carriage casing E. Bars 24 secured to the stays 23 and overlying the upper face of the supporting rails 22 serve to confine the frame 13 against displacement in the casing as the carriage is advanced and partakes of side roll or rocking motion as will later appear. One of the bars 24 may be provided with a flat spring 25 to which is secured a suitable depending lug 26 adapted to snap down behind the rear edge of the reel frame 13 when the latter is slid into place within casing E, thus to lock the frame against endwise displacement. A suitable hook such as the U bolt 27 is secured to the rear of frame 13 to en-

able the desired drag to be hitched to the assembled reel frame and casing. Across the front of the reel frame there is provided a cable guide 28 through which the projected cable passes, the purpose of this guide being to divert the cable away from the flanges and thus toward the center of the take-up reel whenever it tends to pile up adjacent to the flanges or to climb over them.

The carriage casing E may be cylindrical, as shown, although its actual shape may be varied so long as its outer surface is devoid of such projections as might prevent a desirable free sliding, wagging and rolling motion of the carriage when in operation. The casing is preferably left open at its rear end and is made long enough to extend beyond the drag hook at the rear end of the reel frame so as to shield the hitched connection with the hook against snagging with anything. The open end of the casing has the further advantage of enabling the insertion of objects to be conveyed within the casing and thus shielded thereby.

The rigid hollow head piece 29 is preferably conical, as shown, in order to assist in diverting the carriage over and around obstructions. In the particular embodiment under discussion here, the foremost portion of the casing head is constituted by a hollow conical member 30 adapted to rock or wobble on opposed pivots 31 by which it is held to the head piece 29. The apex of this member 30, which may be aptly called the "wobble-nose" of the carriage, is provided with a conical faced bushing 32, said bushing having a smooth central bore for the free passage therethrough of the projected line of cable in its path toward the take-up reel D. As indicated, the pivot axis 31—31 of member 30 intersects the longitudinal axis of the casing E and is disposed normal to said axis and the axis of the take-up reel D at a point forwardly of the mid-point of the latter axis. The actual distance of the axis 31—31 forwardly of the take-up reel is of no particular moment, the important consideration being the distance of the apex of member 30 ahead of the take-up reel and the length of the arc through which said apex is allowed to swing, all as will shortly appear. Further, in the preferred embodiment shown, the apex of member 30 lies in and swings in a common plane with the axis of the casing and the take-up reel. As previously intimated, however, the axis of the take-up reel might well be located somewhat above or below the fore and aft axis of the casing in which case the nose member 30 would swing in an arc parallel to the plane of the reel shaft 14.

The "wobble-nose" referred to serves the combined and important functions (*a*) of facilitating diversion of the carriage over and around obstructions and (*b*) of providing a very simple and effective means for obtaining "level winding" of the courses of the cable B onto the take-up reel. The actions of the "wobble-nose" are illustrated diagrammatically in Fig. 7 wherein it will be observed that the arc of swing of the apex of the nose member 30 is limited by contact of its skirt against the conical head piece 29. The length of this arc is calculated and made directly proportionate to the width of the take-up reel D and the distance of the apex forwardly of said reel, the arrangement being such that as the windings of the taut cable onto the reel approach an end thereof the apex of the nose, when displaced by the taut cable to the limit of its arc of swing toward that end of the reel, exerts sidewise pressure on the cable sufficient by the time it winds clear to the flange of the reel to urge it to feed back toward the other end of the reel. As a result, the windings of the cable are caused to accumulate in substantially even layers back and forth across the width of the reel. The importance of this feature will be realized from the fact that without a "level winding" control the windings of the taut cable would pile up at one or another concentrated point on the reel and rapidly reduce the power ratio to an ineffective value.

Under the most favorable conditions where no obstructions are present to appreciably divert or to produce rolling of the carriage, it will tend to advance on a relatively even keel and in a more or less straight path determined by the alignment of the taut cables B and G. Under such prime conditions the nose 30 will merely wobble slightly from side to side (and the carriage may also wag slightly) as the winding courses of the taut cables B and G shift relatively out of direct fore and aft alignment on their respective reels.

Under conditions unfavorable to a relatively straight course of advance, such as obstructions or other conditions acting to divert the carriage either vertically or sidewise and to produce side roll, the "wobble-nose" 30 will rock in response to the obstruction and/or to the resulting indirect lineal alignment of the carriage and taut cables, the limited arc of swing of the apex being always directionally parallel to the axis of the take-up reel due to the disposition of the pivot axis 31—31 normal to said reel axis. Accordingly, when the cable B is induced by some diversion to wind toward an end of its reel favorable to the direction of such diversion, it may so wind until the opposing urge of the apex on the cable causes it to reverse its direction of feed away from that end of the reel; and the length of arc through which the apex is allowed to swing at a distance forwardly of the reel is calculated to induce such reverse of feed of the cable as it approaches either of the flanged ends of the reel. To explain more specifically, when the apex of nose 30 reaches the limit of its swing in a direction induced by some diversionary influence, the apex reacts with opposing sidewise pressure on the taut cable B, but such pressure may not be sufficient at once to stop the continued winding of the cable toward that flange of its reel to which it is naturally induced to feed by virtue of its tensions and in favor of the diversion. In other words, no matter what the angular disposition of cable B may be beyond the apex, its lateral weave relative to the width of its reel at a given distance forwardly thereof is so limited by the limited swing of the apex as to allow the cable to wind, by virtue of its tensions, over to the appropriate reel flange before the sidewise pressure is sufficient to reverse the feed away from said flange. It is this feature of construction and proportioned relations that allows the windings of the cable B to build up substantially evenly back and forth across the entire width of its reel.

As portrayed in Fig. 7, the "wobble-nose" 30 may be rocked left or right by obstructions only to the limits 30' and 30'' which are fixed by contact of its skirt or base with the conical head 29 of the casing E. These limits are calculated to provide a maximum lateral travel of the cable B commensurate with the width of reel D. The closer the location of the apex of nose 30 to the take-up reel D, the wider must be the arc of

swing allowed the apex in order to effect winding over the entire width of the reel. Should the apex be placed far enough forward of the reel D, it could comprise a fixed aperture, yet the cable would wind back and forth across the reel merely by virtue of the natural tendency of the on-coming stretch of taut cable to ride down beside the previously wound-on coils.

The body or casing E of the carriage may wag to various limits such as E' and E'' according to the varying conditions which may give rise to diversion and misalignment with the taut cables. And the power cable G will, of course, pull from progressively changing lateral points across the reel H up to the limits G' and G''. The "wobble-nose" plays the important part in every instance of diversion or of indirect alignment of the cables of opposing concentration of the windings of the cable B for a protracted period in favor of the direction of diversion or non-alignment of the cables or of the carriage relative thereto.

Application of the apparatus thus far described to the method of the invention is as follows: Assuming that a reel 11 of the cable B to be projected is mounted on the gun 10, the free end of this cable is attached as by a bowline knot to the eyelet on the projectile it is desired to fire. The projectile is then inserted into the gun barrel, the gun, of course, being conditioned as required for firing. Upon firing, the projectile is hurled toward the objective and the attached cable B pays out from the reel 11 under the violent pull of the fired projectile, such pull in turn producing a rotational torque and ultimate rotation of the reel. The firing charge is, of course, suited to the particular type of projectile and the length of cable to be projected, and rotation of the reel is about neutralized by the time the projectile lands. The operator then cuts the cable from its anchorage to the reel 11 and threads it through bushing 32 of the "wobble-nose" 30. The cable is then passed under the cable guide 28 at the front of the withdrawn reel frame unit and hitched to the take-up reel as by looping it through one or more holes, indicated at 33 in Fig. 4, in a flange of this reel. The reel frame unit is now slid onto its supporting rails 22 in the carriage casing until the locking lug 26 snaps in place behind the frame, the cable B and carriage being relatively set in axial alignment with the cable in tension.

Assuming that the desired drag is hitched to hook 27, the power cable G is now unwound by any suitable means such as a vehicle to which it may be hitched as herein shown diagrammatically. The immediate effect is that of forward movement of the carriage due to the take-up reel being driven by chain 19 in the direction of the arrow in Fig. 6 as the power cable reel H is turned in the same direction, the projected cable B coiling onto the reel core 20. As already stated, the ratio of the sprocket drive may be 3 to 1, for example, but the power transmission ratio is considerably greater than this at the start due to the relatively large although gradually decreasing diameter of the coil of power cable G. Further, as previously pointed out, the average advantage of the ratio of the power reel to the take-up reel is calculated always to be sufficient, as cable G pays out and cable B winds onto its reel D, to advance the total applied load.

The cable reels and carriage may, of course, be varied in size to suit different sizes and lengths of cable, and the reels and drive may be altered as to their respective and relative ratios in order to meet different requirements of load, power factor and speed of movement of the carriage.

Turning now to the projectiles, these may also vary in form according to specific requirements. Fig. 8 illustrates one form of projectile designed especially to reverse itself in flight. As indicated, this projectile comprises a round steel bar 34 which is hollowed out over about one-half its length from the cable securing end. It is intended that this type of projectile be inserted in the gun barrel with the light or hollowed end protruding, the cable B being fastened through the eye of a link 35 pivoted on a pin spanning a bifurcation in the exposed end of the projectile. When fired, the heavy end of such a projectile naturally tends to swing into the lead as the cable B pays out from reel 11 and gradually imparts rotation to the latter. Toward the end of its flight a projectile of this type has been found most likely to assume a position favorable to deep penetration or embedding with the heavy end downward and its use, would, of course, be contingent upon the nature of the immediate terrain. The action of a reversible projectile of this general form is diagrammatically illustrated in Fig. 1, the general line of trajectory and several positions of the projectile as it reverses end-for-end in flight being indicated by dotted lines.

In Fig. 9 there is shown one form of a grapnel type of projectile designed to be non-reversible in flight and suited to anchorage by snagging or hooking onto an object or projection it may encounter either upon landing or upon retrograde pull on the projected cable attached to it. This projectile comprises a central rod 36 having a concentric sleeve 37 secured to it as by similar collars 38, the sleeve being perforated to reduce its weight and for other purposes of no direct concern to the instant invention. The sleeve 37 serves to guide the projectile out of the gun barrel when fired. The eyelet collar 39 rigidly secured to rod 36 as by shrinking it in place provides for fastening the cable B to be drawn by the projectile when the latter is fired from a gun. The grapnel head 40 may be of the conical form shown and is provided with projections such as prongs 41 for entangling and gripping purposes in a manner which will be self-evident. The head 40 is preferably a solid member which may be screwed onto the end of rod 36 and it exceeds the weight of that portion of the projectile at the other side of the cable securing eyelet 39, thus tending always to lead during the flight of the projectile.

It will be understood that the cable projecting projectiles just described are merely illustrative of two forms of self anchoring types which may be used to advantage in practicing the invention. It will also be understood that the first step in the practice of the invention—the act of projecting a cable from a base station to an advance point—may be carried out within the scope of the broad method disclosed and claimed in any manner suited to a given situation, whether by means of a projectile fired from a gun or by personnel laying the cable and anchoring it at the advance point.

Considerations of material importance to note in connection with the construction and operation of the advanceable carriage are these: First, the carriage is free to partake of side roll and wagging motions sidewise and endwise as it is moved along the taut projected cable and is diverted over and around obstructions or along irregular terrain. Second, there are no hindrances to the free action of the differential driving mechanism and

connected cables as the carriage rolls and wags, the mechanism being shielded by the surrounding casing against entanglement with outside objects and the cable being free of conflict or snaring with parts within the casing. Third, the arrangement of the cable take-up reel on an axis separate from the axis of the power cable reel permits (*a*) maximum cable capacity on minimum size reels and hence minimum over-all size of the carriage as a whole, and (*b*) minimum lateral width of the reels and therefore less variation from direct alignment of the taut fore and aft cables as their windings shift laterally back and forth across the reels, and less resultant indirect side pull tending to wag the carriage. Fourth, the provision of the rockable head or "wobble-nose" serves, as hereinbefore pointed out, to effectively accomplish the very desirable result of directing the windings of the projected cable in more or less evenly distributed fashion back and forth over the core of the take-up reel as the carriage partakes of its irregular motions. Contributing factors to such even distribution are the disposition of the pivot axis of the nose forwardly of the take-up reel and normal to the axis thereof, and proper proportioning of the limit of swing of the apex of the nose in relation to the width of the reel and distance of the apex forwardly thereof. Fifth, the carriage may be floated during its advance merely by the addition of a buoyancy compartment disposed internally or externally of the casing E. In Fig. 5 there is illustrated schematically by dot-dash lines a water-tight jacket J suitably secured to and partially surrounding the carriage casing E, thus to render the whole carriage buoyant and capable of floating to a degree of submersion determined by the volume of air confined within the water-tight compartment. Sixth, the total load applied between the taut cables (the casing and/or the reel frame alone or with other objects) may be advanced on terrain, in or over water, or in space and at any angle including a vertical posture, all as may be dictated by the directional prevailing conditions and the course and steering effect of the extended cable.

Referring to Fig. 4[a], the power cable reel H may be provided with intermediate separators or flanges X and Y which divide its width into a plurality of sections, each wound to full capacity with the cable G running in a contiguous stretch from one section to the other. The effect of this arrangement is to periodically restore the power ratio for producing advancing movement to a maximum value.

As hereinbefore pointed out, the invention contemplates use of the reel frame unit without its casing for various purposes, for example, to provide motive power for moving a floating conveyance or a land vehicle in the absence or failure of other forms of power. For such applications, the modified form of carriage illustrated in Fig. 4[b] may be employed, such frame being rigidly mounted preferably toward the front end of the object to be moved. Here the reel frame 13 is provided with forwardly converging arms 34 suitably tied together at the front end by a plate 35 and provided at this forward terminal with a rigid cable guide 36. The cable guide 36 serves a purpose similar to that performed by the "wobble-nose" 30 hereinbefore discussed, its vertical legs acting to limit the lateral travel or weave of the projected cable B relative to its reel D and to urge the cable ultimately to feed away from that end of its reel favorable to the direction of diversion of the frame or of the object on which it is mounted. The width between the vertical legs of the guides 36—as with the length of arc of swing of the apex of the nose member 30—is calculated and made proportionate to the width of the reel D and the distance of the guide forwardly of the axis of said reel. And in the manner of the rockable nose member 30, the guide 36 serves as a "level winding" control for the on-coming taut line of cable B.

What I claim is:

1. The method of advancing an object from a base station to an advance point without exposure of personnel between said points, which comprises projecting a single line of cable from said station toward said advance point by attaching one end of the cable to a projectile and firing said projectile; utilizing the resistance of the projectile against displacement due to embedding upon impact at the end of its flight as an anchor against retrograde pull on the projected cable; attaching the base station end of the projected line of cable to a take-up reel and the object to be advanced to a frame supporting said reel; and advancing said frame and object by winding the projected line of cable onto the take-up reel in response to rotation imparted thereto by unwinding a second cable from another reel supported on said frame.

2. The method of advancing a carriage from a base station to an advance point before movement of personnel between said points, which comprises attaching the free end of a cable to a projectile and propelling the latter by gunfire to extend a single line of said cable from the base station to the advance point; utilizing the medium encountered by the projectile at the end of its flight as an anchor for restraining the projected line of cable against retrograde movement; attaching the base station end of the projected cable to a take-up reel mounted on the carriage; and advancing the carriage from the base station to the advance point by unwinding a second cable from a second reel also mounted on the carriage, applying the rotation thus imparted to said second reel to drive the take-up reel to wind the projected line thereon.

3. The method of advancing a carriage from a base station to an advance point without the necessity of movement of personnel between said points, which comprises weighting the leading end of a single line to be projected from the base station to the advance point and forcibly propelling the weighted end of the line toward said point; employing the effect of self-entanglement of the weighted end of the line with an encountered object as an anchor against retrograde movement of the projected line; unwinding a second line from a reel mounted on the carriage and applying the motion thus imparted to said reel to drive an independent second reel also mounted on the carriage; and advancing the carriage by the winding of the projected line onto said second reel in response to said unwinding operation.

4. The method of advancing an object from a base point to an advance point which comprises extending a single line of cable between said points and anchoring it at the advance point, hitching the base end of said line to a take-up reel on a device for holding the object, applying power to drive said reel to wind the extended cable thereon by tugging away from the advance point on a second line of power cable to unwind it from a second reel on said device, and opposing the influence of misalignment fore and aft of the taut extended and power cables to induce

concentration of the windings of the extended cable onto lateral portions of the take-up reel favorable to the direction of misalignment by limiting, at a point in advance of said reel proportioned to its width and the distance of said point forwardly thereof, the extent of weaving of said extended cable relative to said reel.

5. The method of advancing an object from a base point to an advance point which comprises extending a single line of cable between said points and anchoring it at the advance point, hitching the base end of said line to a take-up reel on a device for holding the object, applying power to drive said reel to wind the extended cable thereon by tugging away from the advance point on a second line of power cable to unwind it from a second reel on said device, and causing the windings of the extended cable to accumulate back and forth across the width of the take-up reel in successive substantially level layers by wagging the device so as to alternately dispose the axis of said reel angularly in a direction and to a predetermined extent in opposition to the angular deflection of said axis caused by indirect fore and aft alignment of the taut extended and power cables.

6. Apparatus for advancing an object unattended by personnel from a base station to an advance station comprising, in combination, a single line of cable having one end thereof attached to a projectile, said projectile being adapted to be fired from the base station to extend the cable between said stations and to provide by embedding at the end of its flight an anchor against retrograde movement of the cable, a frame supporting the object to be advanced and rotatably supporting on separate axes transverse to the direction of advance a take-up reel for the extended cable and a power reel having a second single line of cable wound thereon, and driving connections operative in response to rotation imparted to the power reel, by retrograde pull to unwind the cable therefrom, to rotate the take-up reel to advance the frame, the ratio of said connections relative to the power ratio upon exhaustion of the power cable being predetermined to maintain an advantage favorable to advancing movement.

7. Apparatus for advancing an object unattended by personnel from a base station to an advance station comprising, in combination, a single line of cable having one end thereof attached to a projectile adapted to be propelled by gunfire to extend the cable between said stations and to provide by impact an anchor against retrograde movement of the cable; a frame supporting the object to be advanced and provided with parallel front and rear cross shafts; a reel on the front shaft for taking up the extended line of cable; a reel on the rear shaft carrying a wound-up line of cable, and driving connections responsive to rotation imparted by retrograde pull to unwind the cable from the latter reel to rotate the take-up reel to advance the frame, said connections having a fixed driving ratio advantageous to advancing movement until the power cable is exhausted, the ratio of the diameter of the power cable at the core of its reel to the maximum diameter of the extended cable when accumulated on its reel being so proportioned to the driving ratio as to maintain said advantage to advancing movement.

8. Apparatus for advancing an object unattended by personnel from a base station to an advance station, comprising, in combination, a projectile adapted to be propelled by gunfire and

having attached thereto one end of a single line of cable to be projected from the base station toward the advance station, said projectile having means for fixing said projectile in the medium encountered at the end of its flight to provide an anchor against retrograde movement of the projected cable; a take-up reel for the projected cable and a power reel carrying a wound-up line of cable, a frame rotatably supporting said reels, driving connections responsive to rotation imparted to the power reel to rotate the take-up reel to advance the frame, means for imparting retrograde pull to said wound-up line of cable to unwind it and thereby rotate the power reel, said cable on the power reel being wound in a contiguous stretch in adjacent spool-sections formed on said reel whereby to increase the power ratio for driving the take-up reel to a maximum value periodically during the advancing operation.

9. Apparatus for advancing a carriage from a base station to an advance station comprising, in combination, a single line of cable having means attached thereto for anchoring it at the advance station, a carriage having a reel for taking up said cable; said carriage comprising a casing having mounted therein parallel cross shafts, said take-up reel being supported on one of said shafts, and a power reel wound with cable supported on another of said shafts, driving means connecting said reels and operating, by retrograde pull in a direction to unwind the cable from the power reel, to drive the take-up reel and concurrently to advance the carriage, and a conical nose member pivoted on said carriage forwardly of the take-up reel for swinging of its apex longitudinally of said cross shafts with the extended line of cable passing through said apex in its path toward said reel, said nose member being adapted for rocking by obstructions to a direct path of movement of the carriage toward the advance station and in response to relative lateral shifting in the fore and aft alignment of the winding and unwinding courses of the respective taut cables, said rocking movements of said nose member relative to the take-up reel effecting a substantial level-winding of the extended cable upon said reel.

10. A combination as set forth in claim 9, wherein the axis of rocking movement of the conical nose member is positioned so as to limit the length of arc through which the apex of said member may swing by contact of said member with the casing, the length of said arc being proportioned to the width of the take-up reel and the distance of said apex forwardly of the axis of said reel.

11. A combination as set forth in claim 9, wherein the carriage casing comprises a substantially cylindrical body adapted to roll and wag sidewise as it advances between the taut extended and power cables, and wherein the cross shafts supporting the take-up and power cable reels are carried on a frame removably supported within the casing and means is provided for retaining said frame against movement relative to the casing as the carriage rolls and wags.

12. A combination as set forth in claim 9, wherein the carriage casing comprises an elongated substantially cylindrical body open at its rear end and adapted to roll and wag sidewise as the carriage advances between the taut extended and power cables, and wherein the cross shafts for the take-up and power cable reels are journaled in a frame removably supported on rails secured within the casing, said rails

being formed to retain said frame fixed relative to the casing as the latter rolls and wags and being provided with releasable locking means cooperative with the frame to permit its removal endwise through the open end of said casing.

13. Apparatus for advancing a carriage from a base station to an advance station comprising, in combination, a single line of cable having means attached thereto for anchoring it at the advance station, a carriage having a reel for taking up the cable to advance said carriage; an elongated carriage casing having mounted therein normal to its longitudinal axis and direction of advance a cross shaft supporting the take-up reel and a similar shaft parallel thereto rotatably supporting a power reel wound with cable, said power reel being drivingly connected to the take-up reel to wind the extended cable thereon in response to rotation imparted by tugging on the power cable in a direction away from the advance point to unwind said cable from its reel; and a conical nose member pivoted on the carriage casing forwardly of the take-up reel for swinging of the apex thereof laterally of the fore and aft axis of the carriage, the extended line of cable passing through said apex in its path toward the take-up reel and obstructions to a direct path of advance of the carriage rocking said nose member and diverting the carriage angularly relative to the taut lines of extended and power cables, sidewise pressure exerted on the extended cable by said apex due to such diversion of the carriage urging the winding coils of the extended cable to feed laterally onto portions of the take-up reel favorable to true alignment of the carriage and cables.

14. Apparatus for advancing an object from a base station to an advance station comprising in combination, a single line of cable having means attached thereto for anchoring it at the advance station and extending to a reel for taking up said cable; parallel cross shafts mounted on a frame secured to the object to be advanced and extending normal to the direction of advance, said shafts supporting respectively the take-up reel and a power reel wound with cable; means for driving the take-up reel to advance the object by rotation imparted to the power reel upon retrograde pull to unwind the cable from the latter reel, and fixed means on the frame cooperative with the extended cable at a point forwardly of the mid-point of the take-up reel and operative to limit the extent of weaving of said cable laterally of its reel to an amount proportioned to and less than the width of said reel.

15. Apparatus for advancing a carriage from a base station to an advance station comprising, in combination, a single line of cable having means attached thereto for anchoring it at the advance station and extending to a reel on the carriage for taking up said cable; parallel front and rear cross shafts on the carriage supporting respectively the take-up reel on the forward shaft and a power reel wound with another single line of cable on the rear shaft; means for driving the take-up reel to advance the carriage by rotation imparted to the power reel upon retrograde pull to unwind the cable from the latter reel, and a conical nose member pivoted on the carriage forwardly of the take-up reel, means for passing through the apex of said member the extended line of cable in its path toward said reel, and the pivot axis of said member being disposed normal to the axis of said reel and the extended line of cable whereby to rock in correspondence with non-alignment fore and aft of the carriage with the taut extended and power cables, said nose member being operative to exert pressure on the extended cable in a lateral direction opposed to that induced by the incident relative non-alignment of said cables and carriage whereby to urge the windings of the extended cable to feed in said lateral direction onto the take-up reel.

16. A combination as set forth in claim 9, wherein the carriage casing comprises an elongated cylindrical body adapted to roll and to wag sidewise as it advances, and wherein the reel supporting cross shafts are disposed within said casing one behind the other normal to and in a common plane with the fore and aft axis of the carriage casing, and wherein the pivot axis of the conical nose member is disposed normal to said plane and intersects said axis of the casing whereby its apex swings in an arc parallel to said common plane as the carriage rolls and wags.

17. A combination as set forth in claim 9, wherein the pivot axis of the conical nose member intersects the fore and aft axis of the carriage casing and is disposed normal to said axis and the axes of the reel supporting cross shafts, and wherein the length of the arc of swing of the apex of said nose member and its location forwardly of the axis of the take-up reel are proportioned to the width of said reel.

18. A combination as set forth in claim 9, wherein the pivot axis of the conical nose member intersects the fore and aft axis of the carriage casing and is disposed normal to the axes and plane of the reel supporting cross shafts, and wherein the apex of said nose member is located for swinging in the latter plane to an extent, back and forth across said axis of the carriage casing, proportioned to the width of the take-up reel.

19. Mechanism adapted for movement from a base station to an advance station by power applied in a direction away from the advance station comprising, in combination, a single line of cable extending between said stations having one end thereof attached to a reel on said mechanism for taking up said cable and the other end attached to an anchor against retrograde movement from the advance station, a pair of parallel cross shafts mounted on said mechanism on axes normal to the direction of advance and supporting respectively the take-up reel and a wound-up reel of power cable, driving connections between said reels operative to rotate the take-up reel to advance said mechanism in response to rotation imparted by tugging backwardly on the power cable, and means positioned on said mechanism to act on the extended line of cable at a point forwardly of the take-up reel and operative to urge said cable to feed laterally away from end portions of its reel favorable to indirect lineal alignment of the taut cables and of said mechanism relative to said cables.

20. Mechanism adapted for movement from a base station to an advance station by power applied in a direction away from the advance station comprising, in combination, a single line of cable extending between said stations having one end thereof attached to said mechanism and the other end attached to an anchor against retrograde movement from the advance station, a

pair of parallel cross shafts mounted on said mechanism, one supporting a reel for taking up the extended line of cable and the other a reel provided with a wound up line of power cable, driving connections between said reels operative to rotate the take-up reel to advance said mechanism in response to rotation imparted by tugging backwardly on the power cable, and means cooperative with the extended line of cable at a point forwardly of the take-up reel proportioned to the width of said reel and operative by sidewise pressure on said cable to maintain within predetermined limits alignment of said mechanism with the taut lines of cables.

21. Mechanism adapted for movement from a base station toward an advance station by power applied in a direction away from the advance station comprising, in combination, a single line of cable extending between said stations having one end thereof attached to said mechanism and the other end attached to an anchor against retrograde movement from the advance station, a pair of parallel cross shafts mounted on said mechanism, one supporting a reel for taking up the extended line of cable and the other a reel provided with a wound up line of power cable, driving connections between said reels operative to rotate the take-up reel to advance said mechanism in response to rotation imparted by tugging backwardly on the power cable, and means cooperative with the exended line of cable at a point forwardly of the take-up reel and operative to direct the windings of said cable away from that side of the core of said reel to which said windings are induced to feed in response to angular alignment of the taut extended and power cables relative to a direct lineal course between the base and advance stations.

22. Apparatus for advancing a carriage from a base station to an advance station comprising, in combination, a single line of cable having means attached thereto for anchoring it at the advance station, a carriage having a reel for taking up said cable; a carriage casing having mounted therein separate parallel cross shafts supporting, respectively, the take-up reel and a power reel wound with cable and adapted upon rotation imparted by retrograde pull to unwind the cable from the latter reel to drive the take-up reel to advance the carriage, means drivingly connecting the power reel to the take-up reel, and a conical nose member pivoted on the carriage ahead of the reel supporting shafts on an axis normal to said shafts for swinging of the apex thereof in a direction longitudinally of the said shafts, means for passing through said apex the extended line of cable in its path toward the take-up reel and said nose member being adapted to rock upon encountering an obstruction to a direct line of advance of said carriage, sidewise pressure exerted on the extended line of cable by said apex when rocked urging the windings of said cable to alter their course laterally of the take-up reel to compensate for relative angular alignment of the taut lines of the extended and power cables due to the diversionary influence of the obstruction on said carriage.

23. A combination as set forth in claim 20, including a water-tight compartment secured to said shaft-supporting mechanism and adapted to keep said mechanism afloat during its advance between the taut lines of cables.

24. Mechanism adapted for movement from a base station to an advance station by power applied in a direction away from the advance station comprising, in combination, a single line of cable extending between said stations having one end thereof attached to said mechanism and the other end attached to an anchor against retrograde movement from the advance station, a pair of parallel cross shafts mounted on said mechanism, one supporting a reel for taking up the extended line of cable and the other a reel provided with a wound up line of power cable, driving connections between said reels operative to rotate the take-up reel to advance said mechanism in response to rotation imparted by tugging backwardly on the power cable, and means cooperative with the extended line of cable at a point forwardly of the take-up reel proportioned to the width of said reel and operative by sidewise pressure on said cable within lateral limits proportioned to the distance of said means forwardly of said reel to urge said mechanism to advance in alignment with the taut lines of cables.

25. Mechanism adapted for movement from a base station to an advance station comprising, in combination, a single line of cable extending between said stations having one end thereof anchored at the advance station and the other end attached to a reel on said mechanism for taking up said cable, a shaft supporting said reel and extending transverse to the direction of advance, another shaft on said mechanism supporting a second reel provided with a wound-up line of power cable, driving connections operative to rotate the take-up reel to advance the mechanism in response to rotation imparted by tugging on the power cable to unwind it from its reel, and means cooperative with the extended line of cable at a predetermined distance forwardly of the take-up reel and operative to limit the lateral weave of the cable relative to the reel to an amount proportioned to said distance and the width of said reel.

26. The method of advancing an object from a base station to an advance point without exposure of personnel between said points which comprises projecting a single line of cable from said station toward said advance point by attaching one end of the cable to a projectile and firing said projectile; ballistically directing the projectile to cause it to fix itself in the medium encountered adjacent said advance point so as to resist retrograde pull on the projected cable; connecting an object to be advanced to the base-station end of said projected cable; and advancing said object toward said advance point by taking up the projected cable at said object.

27. The method of advancing an object from a base station to an advance point without exposure of personnel between said points, which comprises projecting a single line of cable from said station toward said advance point by attaching one end of the cable to a projectile and firing said projectile; ballistically directing the projectile to cause it to fix itself in the medium encountered adjacent said advance point so as to resist retrograde pull on the projected cable; connecting an object to be advanced to the base-station end of said projected cable; and advancing said object toward said advance point by reeling in the projected cable at said object.

28. The method of advancing an object from a base station to an advance point without exposure of personnel between said points, which comprises projecting a single line of cable from said station toward said advance point by attaching one end of the cable to a projectile and firing said projectile; ballistically directing the

projectile to cause it to fix itself in the medium encountered adjacent said advance point so as to resist retrograde pull on the projected cable; connecting a reel to be advanced to the base-station end of said projected cable; and advancing said reel toward said advance point by turning the reel to take up the projected cable from its base-station end.

29. The method of advancing an object from a base station to an advance point without exposure of personnel between said points, which comprises projecting a single line of cable from said station toward said advance point by attaching one end of the cable to a projectile and firing said projectile; ballistically directing the projectile to cause it to fix itself in the medium encountered adjacent said advance point so as to resist retrograde pull on the projected cable; connecting a reel to be advanced to the base-station end of said projected cable; and advancing said reel toward said advance point by turning the reel to take up the projected cable from its base-station end the turning of said reel being powered by unreeling a second line of cable connected to the rotational mechanism of said reel.

30. Apparatus for advancing a portable object from a base station to an advance point across the intervening terrain which includes in combination a projectile, means for firing and guiding said projectile in flight, a cable having its advance end attached to the projectile and being mounted adjacent said firing means to pay out freely behind the projectile in fight, said projectile being shaped and weighted to imbed itself at the end of its flight in the medium there encountered to act as an anchor against retrograde pull on the cable, an object to be advanced over the terrain along which the projected line of cable lies, winding means connected to said object and to the base end of said projected cable, a wound up line on a reel drivingly connected to said winding means, and means for turning said winding means by unreeling said wound-up line through retrograde pull thereon, the turning of said winding means causing said object to advance along the single line of cable toward the advance point.

31. Mechanism adapted for movement from a base station toward an advance station by power applied to said mechanism in a direction away from said advance station comprising, in combination, a single line of cable extending between said stations and having one end thereof attached to said mechanism and the other end anchored at the advance station, a pair of parallel cross shafts mounted on said mechanism, said shafts rotatably supporting respectively a reel for taking up the extended line of cable and a reel provided with a wound-up line of cable for applying power to move said mechanism, flange members on the latter reel dividing it width-wise into a plurality of sections, said power cable being wound to the capacity of the successive sections and in a contiguous stretch from one section to the other, means drivingly connecting said reels and operating, in response to rotation imparted to the power reel by tugging backwardly to unwind the cable therefrom, to rotate the take-up reel and thereby to take up the extended line of cable and concurrently advance the mechanism therealong toward the advance station, reduction in the rate of advance of said mechanism due to the gradually increasing diameter of the windings onto the take-up reel being offset by the gradually decreasing diameter of the windings of the power cable as the latter pays out from the successively wound sections of its reel.

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