

Jan. 15, 1963

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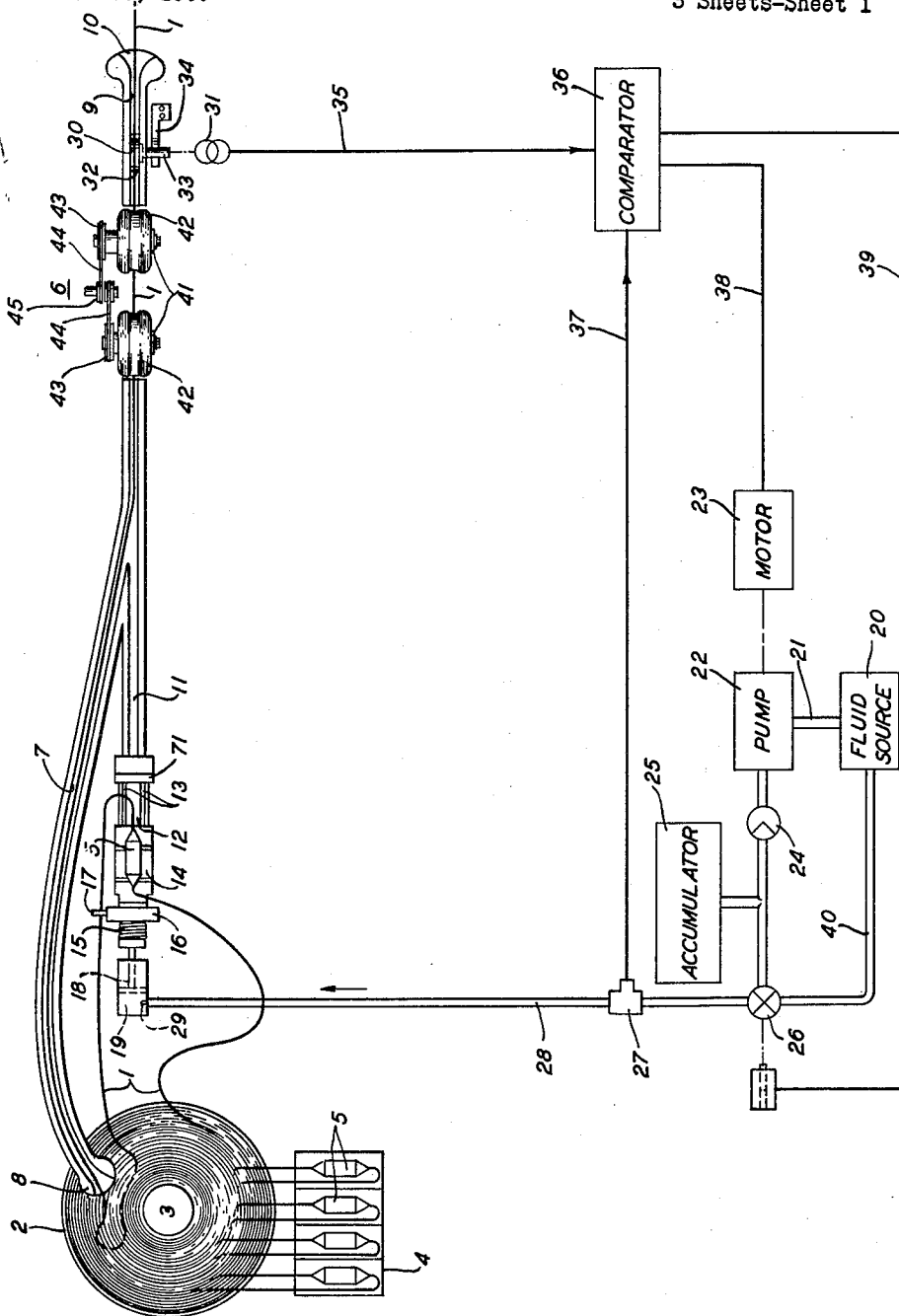
3,073,496

VARIABLE VELOCITY SPRING CATAPULT

Filed Dec. 30, 1960

3 Sheets-Sheet 1

FIG. 1



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FIG. 2

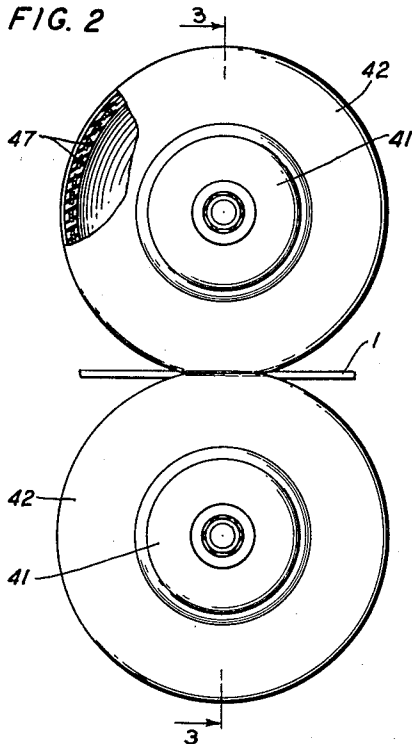


FIG. 3

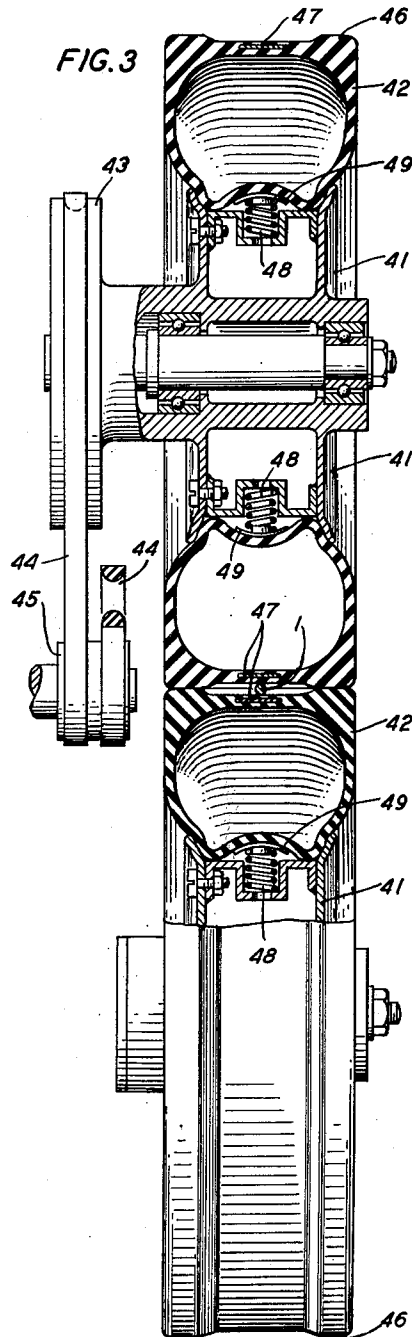
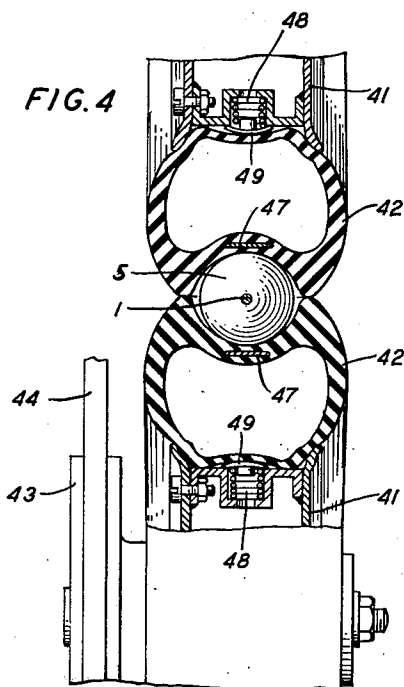


FIG. 4



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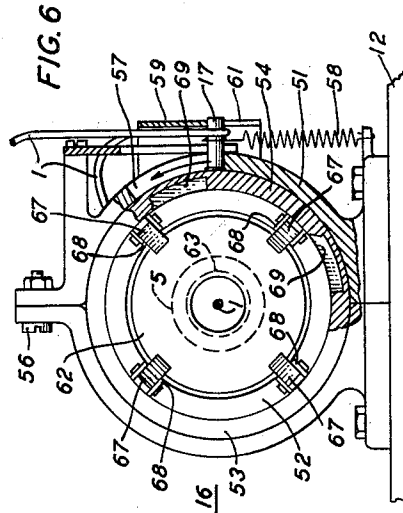
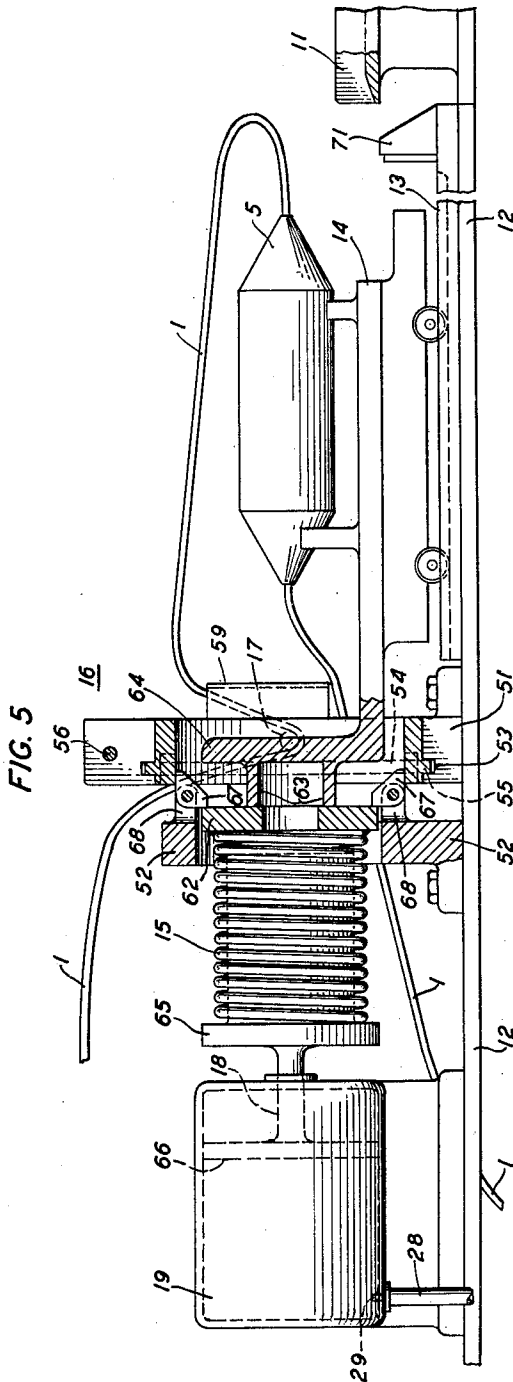
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3 Sheets-Sheet 3



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VARIABLE VELOCITY SPRING CATAPULT

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9 Claims. (Cl. 226-24)

This invention relates to a catapult for launching or propelling an object and, more particularly, to a variable velocity spring catapult. The invention is especially useful when it is associated with equipment for laying communication cable of the underwater type having instrumentality housings such as repeaters, as the invention can be advantageously employed for launching these housings at a velocity corresponding to the instantaneous rate at which the cable is being payed out.

As is well understood in the art, underwater communication cable, which is also known as ocean cable, is usually provided with integral enlargements or lumps at spaced intervals along its length. These lumps are constituted by instrumentality housing structures which may be of either flexible or rigid construction and which contain electric instrumentalities forming such equipment as repeaters or equalizers. Since there are various types of underwater cable which each have different characteristics, the sizes and weights of the instrumentality housings, as well as the spacings between them, vary with the particular type of cable in which they are used.

During the process of laying ocean communication cable, the cable is usually coiled in a stowage tank in the hold of a ship and is payed out into the ocean by means of some type of cable-handling apparatus. This cable-handling apparatus may also be employed for paying out the instrumentality housings by means of a process which involves the use of the cable for pulling the housings from their place of stowage. Since the housings are normally in a state of rest, it can be understood that, when the moving cable starts to pull one of the housings, the inertia of that housing will impose a tensile stress upon the cable. In other words, under this procedure, the force required to launch a housing from a state of rest to a velocity equal to the velocity of the cable is provided by the tension in the cable.

This method is not fully satisfactory because, under some circumstances, the resulting tension in the cable may reach a peak which is greater than the breaking strength of the cable. For this reason, it is preferable to employ some other force for launching the instrumentality housings. The particular means selected for applying this launching force should be capable of imparting just the right amount of force needed for launching a housing at the same velocity as the instantaneous velocity of the cable. However, this requirement is complicated by the fact that the rate at which the cable is payed out into the ocean may vary from time to time due to various factors; such as fluctuations in the tension in that portion of the cable which is supported between the ocean floor and the cable-laying ship, variations in the speed at which the cable-laying ship is traveling, and changes in the degree of control applied to the cable by the cable-handling apparatus. Therefore, a launching force which might be appropriate at one time during cable-laying operations would not necessarily be suitable at another time.

Accordingly, it is an object of this invention to provide improved means for launching instrumentality housings which are connected integrally in a communication cable.

It is also an object of this invention to provide improved means in cable-laying equipment for launching cable instrumentality housings at a velocity correspond-

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ing to the instantaneous rate at which their associated cable is being payed out.

An additional object of the invention is to provide an improved catapult for launching cable instrumentality housings.

A further object of the invention is to provide an improved variable velocity spring catapult.

Still another object of the invention is to provide improved means for varying the compression of the operating spring of a spring catapult.

These and other objects of the invention are accomplished by employing launching apparatus comprising a spring catapult having improved means for varying the degree of compression of its operating spring. This operating spring, which may conveniently be in the form of a helix, is so selected as to be capable of storing sufficient energy, when compressed, for properly launching cable instrumentality housings. In an exemplary embodiment of the invention, the equipment for compressing the operating spring includes a piston having one end abutting against an end of the helical spring and having its head contained within a cylinder for sliding movement therein. The cylinder is provided with an orifice for admitting therein an appropriate fluid.

This fluid is subjected to pressure from a suitable pressure source so that, when it is forced into the cylinder, it will push the piston against the above-mentioned end of the spring. This action will tend to compress the spring if the other end of the spring is restrained from moving. Proper restraint of the spring can be obtained by utilizing a suitable triggering device for temporarily holding this end of the spring until such time as the launching action is to be performed.

The launching apparatus of this illustrative embodiment of the invention further includes a suitable movable carriage for holding an instrumentality housing in position for being launched. This carriage is located in such a manner as to receive the impact of the propulsive force of the spring when the spring is released by the triggering device. Since the sudden release of the spring would have a tendency to permit a somewhat similar sudden release of the piston, such movement of the piston is restrained by constructing the above-mentioned orifice so that it has a time constant which is large compared to the launching time of the catapult and thereby serves to function as a throttling orifice.

In order for the instrumentality housings to be launched at a velocity corresponding to the instantaneous rate at which the cable is being payed out, control means are employed for providing a linear correlation between the pressure in the cylinder and the velocity to which the housings are to be accelerated. In other words, the fluid pressure in the cylinder is continuously controlled as a function of the cable velocity. Thus, during the time that the cable is being payed out, the fluid pressure source is controlled in such a manner as to introduce sufficient fluid into the cylinder until the force from the piston is balanced by the force from the compressed spring. This applied fluid pressure is continuously controlled so that it will vary as a function of the instantaneous cable pay-out rate. Therefore, the compression of the spring will be correspondingly continuously controlled so as to be capable of producing a propulsive force sufficient to accelerate an instrumentality housing to the required launching velocity.

These and other features of the invention are more fully discussed in connection with the following detailed description of the drawing in which:

FIG. 1 is a plan view of cable instrumentality launching equipment in accordance with this invention and shown in its relation to a cable stowage tank and suitable cable-handling apparatus;

FIG. 2 is a side view, partly in section, of a portion of

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the cable-handling apparatus shown in its relation to a cable which is being payed out;

FIG. 3 is an end view, mainly in section, of a larger portion of the cable-handling apparatus with the cable passing therethrough;

FIG. 4 is another end view, partly in section, of a smaller portion of the cable-handling apparatus with one of the instrumentality housings passing therethrough;

FIG. 5 is a side view, partly in section, of the launching equipment including its carriage having a cable instrumentality housing supported thereon; and

FIG. 6 is an end view, partly in section, of the triggering apparatus employed in the launching equipment.

In FIG. 1, a supply of underwater communication cable 1 is represented as being coiled in a stowage tank 2 provided with the customary spacing core 3 in its center. Adjacent to the tank 2 is a stowage rack 4 on which a number of cable instrumentality housings 5 are placed. For the purpose of simplicity in the following description, these instrumentality housings 5 will be referred to simply as "housings 5." Since the housings 5 are connected integrally into the cable 1 at spaced intervals, portions of the cable 1 extend from the tank 2 to each end of each of the housings 5.

During cable-laying operations, the cable 1 is pulled out of the tank 2 and is payed out into the ocean or other body of water by means of suitable cable-handling apparatus, such as a multiple cushion tire engine 6. A trough 7 is provided for guiding the passage of the cable 1 from the tank 2 to the engine 6. One end 8 of the trough 7 is suspended above the central portion of the tank 2. This end 8 of the trough 7 is flared and is bent downward to facilitate the upward movement of the cable 1. The trough 7 is constructed with a suitable cross-sectional shape, such as a round bottom with outwardly sloping sidewalls, which is designed to constrain sidewise motion of the cable 1 while presenting minimal interference to its longitudinal motion. Another trough 9 is located between the cable engine 6 and the point where the cable 1 enters the water. The outboard end 10 of this trough 9 is flared so as to function as an overboarding chute.

A third trough 11 extends from an intermediate point of the trough 7 to a catapult launching platform 12. The platform 12 is equipped with rails 13 for guiding the movement of a carriage 14 which is adapted to support one of the housings 5. The carriage 14 is designed to be propelled by a coiled helical spring 15 under the control of a device 16 provided with a trigger 17. This trigger 17 has a portion of the cable 1 looped around it for effecting its operation when the slack in this cable portion is reduced during the process of paying out the cable 1. The spring 15 is normally compressed by the action of a piston 18 having its head contained within a fluid chamber or cylinder 19. The detailed construction of this catapult launching equipment is more clearly shown in FIGS. 5 and 6 and is fully explained hereinafter.

As was stated above, the compression of the spring 15 is continuously controlled for the purpose of providing a propulsive force sufficient to accelerate a housing 5 to the launching velocity required at any particular time. This is accomplished in accordance with this invention by employing control means for establishing and continuously maintaining a linear correlation between the fluid pressure in the cylinder 19 and the velocity to which the housings 5 are to be accelerated.

These control means include a fluid supply source 20 connected by a pipe 21 to a conventional pump 22 adapted to be operated by a suitable electric motor 23. Fluid driven by the pump 22 passes through a check valve 24, which may be of any appropriate type, and enters a suitable accumulator 25. From this point, the fluid travels through a conventional solenoid-operated bleed valve 26 and a pressure transducer 27 of appropriate design. The fluid then travels through a pipe 28 leading to an orifice 29 in the cylinder 19. This orifice 29, which is shown in

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FIG. 5, has a substantially smaller inside diameter than that of the pipe 28 so that it functions as a throttling orifice for preventing any appreciable movement of the piston 18 when one of the housings 5 is launched.

Thus, by operating the pump 22, fluid from the source 20 will travel through the pipe 28 and will enter the cylinder 19. The resulting fluid pressure will be exerted against the head of the piston 18 and will force the piston 18 to move to the right thereby compressing the helical spring 15.

In order to correlate this fluid pressure with the pay-out velocity of the cable 1, a tachometer is employed for producing a voltage proportional to the velocity of the cable 1. This tachometer may be of any suitable design, such as a wheel 30 adapted to be rotated by the cable 1 for driving a motor-generator 31. The wheel 30 can conveniently be mounted immediately beneath the trough 9 and, to enable the rim of the wheel 30 to engage the cable 1, a small slot 32 can be cut in the bottom of the trough 9 to permit the top portion of the wheel 30 to protrude upwardly therethrough. The wheel 30 is fixedly secured to a rotatable shaft which is connected through a bushing 33 to the motor-generator 31. A small leaf spring 34 is so disposed as to press upwardly against the bushing 33 thereby holding the top of the wheel 30 in engagement with the moving cable 1. The flexibility of the spring 34 also serves to allow the wheel 30 to move downward when one of the housings 5 passes along the trough 9.

Thus, during the time that the cable 1 is being payed out, the cable 1 will engage the top of the wheel 30 and will cause it to rotate. This rotary motion of the wheel 30 will be transmitted by its shaft to the motor-generator 31. Accordingly, the motor-generator 31 will function, in a manner well understood by those skilled in the art, to produce a voltage proportional to the speed of rotation of the wheel 30 and its shaft. Since the rate of rotation of the wheel 30 varies directly with variations in the rate at which the cable 1 is payed out, then it follows that the output voltage produced by the motor-generator 31 will be proportional to the cable pay-out rate and will vary in accordance with variations therein.

The voltage produced by the motor-generator 31 is transmitted over an electric conductor 35 to a suitable comparator 36. The comparator 36 is provided with another input lead 37 extending from the output of the pressure transducer 27. This pressure transducer 27 may be of any appropriate design and may be a strain gauge employing a suitable device for producing a voltage, in a manner well known to those skilled in the art, which will be proportional to the fluid pressure in the pipe 28.

These two voltages thus applied to the comparator 36 are oppositely combined therein to produce a difference voltage which will be either negative or positive depending on which of the input voltages is the larger. The difference voltage is used in the comparator 36 to control the operation of a device, such as a polarized relay. This device functions to apply electric control potential alternatively either to a lead 38 extending to the pump motor 23 or to a lead 39 connected to the solenoid-operated bleed valve 26. If desired, the circuits in the comparator 36 can be so arranged that the potential applied to the lead 38 will be of opposite polarity to the potential applied to the lead 39.

Thus, during cable-laying operations, the comparator 36 will strive to establish and maintain an equilibrium between its two input voltages. For example, if the voltage supplied by the motor-generator 31 should be larger than the voltage produced by the transducer 27, then the comparator 36 would apply a control potential to the lead 38. This would effect the operation of the motor 23 which, in turn, would cause the pump 22 to supply more fluid to the cylinder 19 to increase the pressure therein. This action would continue until the control

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voltages supplied over the leads 35 and 37 become equal. When this occurs, the comparator 36 will cease to produce an output control potential and the motor 23 will discontinue operation of the pump 22.

Whenever the voltage from the transducer 27 becomes larger than the voltage from the motor-generator 31, the comparator 36 will apply a control potential to the lead 39 for energizing the solenoid-controlled bleed valve 26. Upon being energized, the bleed valve 26 will open a normally closed entrance to a pipe 40 which is connected between the bleed valve 26 and the fluid source 20. This will allow some of the fluid in the pipe 28 and the cylinder 19 to flow back to the fluid source 20. The resulting reduction in the pressure of the fluid in the pipe 28 and the cylinder 19 will produce a corresponding diminution of the voltage supplied by the transducer 27 to the lead 37. When the voltage from the lead 37 becomes equal to the voltage in the lead 35, the output voltage from the comparator 36 will be discontinued and the solenoid-operated bleed valve 26 will close the entrance to the pipe 40.

In this way, the comparator 36 will constantly tend to equalize the voltages from the pressure transducer 27 and the motor-generator 31 so that the compressive force of the spring 15 will be varied in accordance with variations in the cable pay-out rate. Therefore, the spring 15 will be so controlled as to always have sufficient propulsive force to launch the housings 5 at a velocity equal to the velocity of the cable 1. This enables the housings 5 to be launched without any interruption of the cable-laying process so that the entire procedure can be performed in one continuous operation.

To further aid in laying the cable 1 and its housings 5 in one continuous operation, it is desirable to employ cable-handling apparatus which is so designed as to permit the housings 5 to pass therethrough without any reduction of the pay-out rate. Suitable apparatus for this purpose is represented in FIG. 1 by the multiple cushion tire engine 6 which comprises two pairs of wheels 41 each having mounted thereon a cushion type tire 42. The tires 42 are of resilient construction and each is filled with a suitable fluid. The wheels 41 in each pair are mounted in opposition, one above the other, and are loaded, or pressed together, so as to form a substantial flat meeting area of their tires 42, as is shown in FIG. 2.

The cable 1 is guided between the tires 42 at their meeting area, as is represented in FIG. 2, and is securely gripped by the loading pressure at this point. The pay-out movement of the cable 1 is controlled by the rotation of the wheels 41. In order to rotate or drive the wheels 41, the hub of each wheel 41 has a pulley 43 securely fastened thereto, as is shown in FIG. 3. Each pulley 43 is connected by a belt 44 to another pulley 45 which is driven by a motor. For the purpose of simplicity, this motor is not shown in the drawing as it may be any suitable conventional type of motor which can be operated at various speeds.

The tires 42 are fabricated with a high shoulder tread, as is indicated by the reference numeral 46 in FIG. 3. The tread of each tire 42 has embedded therein a series of small metallic stiffener plates 47. These plates 47, in effect, present to the cable 1 the profile of a cylindrical roller and aid in concentrating or amplifying the gripping pressure exerted by the tires 42 against the cable 1.

The passage of a housing 5 through the engine 6 is made possible by the deflection of the tires 42, as is illustrated in FIG. 4. Since this deflection has a tendency to compress or displace the fluid within the tires, the rim of each wheel 41 is equipped with a number of radially disposed coiled springs 48. Each of these springs 48 is so constructed and arranged as to press against a respectively associated plate or cap 49 which, in turn, presses against its associated tire 42. During the passage of the cable 1 between the tires 42, the springs 48 are in their extended positions, as is represented in FIG. 3. Under this con-

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dition, the springs 48 push their respectively associated caps 49 against the tires 42 thereby maintaining the internal fluid pressure within the tires 42.

When a housing 5 is to be fed through the engine 6, the deflection required to permit the passage of the housing 5 will be shared by the two tires 42 in each pair of wheels 41. The resulting displacement of the fluid within the tires 42 forces the caps 49 against the springs 48 to produce a corresponding displacement of the springs 48, as is shown in FIG. 4. In this manner, the housings 5 can be fed through the engine 6 along with the cable 1 in one continuous operation and with adequate control of the cable pay-out rate being maintained at all times.

It was stated above that, when one of the housings 5 is to be launched, it is placed on a carriage 14 which is adapted to be propelled by a spring 15 under the control of a device 16 which is schematically represented in FIG. 1 as being provided with a trigger 17. This control device 16 is illustrated in detail in FIGS. 5 and 6 wherein it is shown to comprise two substantially circular brackets 51 and 52 which are bolted securely to the launching platform 12. The bracket 51 has an interior channel 53 within which the peripheral flange 55 of a ring 54 is mounted for rotation. To facilitate the insertion of the flange 55 inside the channel 53, the bracket 51 is made in two halves which are fastened together by a bolt 56.

The rotation of the ring 54 is effected by the trigger 17 which has one end securely fastened to the rim of the ring 54. The other end of the trigger 17 projects outwardly through a vertical slot 57 in the bracket 51. The trigger 17 is normally held against the bottom of the slot 57 by a spring 58. When in this position, the trigger 17 holds a loop of that portion of the cable 1 which extends from the front end of the housing 5 to the stowage tank 2.

During the process of paying out the cable 1, there will eventually come a time when that portion of the cable 1 between the stowage tank 2 and the trigger 17 will be paid out. After the slack in this portion of the cable 1 has been fed into the trough 7, the remainder of this portion of the cable 1 will become taut and will consequently pull upwardly against the trigger 17. As this upward force is considerably greater than the downward force exerted by the spring 58, the trigger 17 will move upward in the direction of the arrow shown in FIG. 6. Since the trigger 17 is attached to the ring 54, the upward movement of the trigger 17 will cause the ring 54 to rotate in the same direction; namely, in the direction of the arrow shown in FIG. 6. This upward movement ends when the trigger 17 reaches a position which is tilted sufficiently to permit the loop of cable 1 to slide off the trigger 17 and thereby become free.

In order to prevent the loop of cable 1 from slipping off the trigger 17 prematurely, a guard frame 59 is constructed around the trigger 17. This guard frame 59 may conveniently be in the form of a box having an open top and bottom. The open top allows the cable 1 to emerge freely therefrom. The open bottom permits the spring 58 to pass therethrough and is also of assistance in initially looping the cable 1 around the trigger 17. The front of the guard frame 59 is provided with a vertical slot 61 for guiding the upward movement of the trigger 17.

The function of the rotatable ring 54 is to control the movement of another ring 62 which is normally located within the circular bracket 52. The ring 62 is so constructed that its outside diameter is smaller than the inside diameter of the rotatable ring 54. One side of this ring 62 is fastened by rods 63 to the upright end 64 of the launching carriage 14. The other side of the ring 62 abuts against an end of the coiled spring 15 which has its other end fastened to the front end 65 of the piston 18. The head 66 of the piston 18 is located within the fluid cylinder 19. It should be noted that the outside diameter of the coiled spring 15 is smaller than the outside diameter of the ring 62. Although the spring 15 tends to push the

ring 62 forward, this action is normally prevented by a plurality of pivot arms 67.

These pivot arms 67 are pivotally mounted in brackets 68 which are secured to the face of the circular bracket 52. The mounting is of such construction as to permit the pivot arms 67 to rotate radially outward. However, such rotation of the pivot arms 67 is normally prevented by the abutment of the front ends of the pivot arms 67 against the surface of the inner face of the rotatable ring 54 as is represented in FIG. 5. When the pivot arms 67 are held in this position, their bottom ends protrude immediately in front of the outer face of the ring 62. The pivot arms 67 thus function as stops for holding the ring 62 in the position shown in FIG. 5.

In order to permit the outward rotation of the pivot arms 67, the rotatable ring 54 is provided with a plurality of recessions 69. As is illustrated in FIG. 6, these recessions 69 are cut in the inner edge of the inside face of the rotatable ring 54 and are normally located immediately to one side of those portions of the surface of the ring 54 which are engaged by the pivot arms 67. When the ring 54 is rotated in the manner described above, the recessions 69 are thereby moved in front of the respectively associated pivot arms 67. This permits the pressure exerted by the spring 15 against the ring 62 to rotate the pivot arms 67 sufficiently to move their bottom ends out of engagement with the ring 62.

This frees the ring 62 and also permits axial expansion of the coiled spring 15. As both the ring 62 and the spring 15 have outside diameters which are smaller than the inside diameter of the rotatable ring 54, both the ring 62 and the spring 15 can pass through the ring 54. Accordingly, the propulsive force produced by the axial expansion of the spring 15 will thrust the ring 62 through the circular opening in the rotatable ring 54. Since the ring 62 is attached to the launching carriage 14, the thrust imparted to the ring 62 will also be applied to the carriage 14. Therefore, the carriage 14 and the housing 5 mounted thereon will be suddenly propelled forward along the rails 13.

The forward movement of the carriage 14 is abruptly halted when it encounters a bumper 71 fastened to the launching platform 12 across the path of the rails 13. The resulting sudden stop of the carriage 14 causes the housing 5 to slide off into the trough 11. The impetus or launching force thus imparted to the housing 5 is adjusted, in the manner explained above, so that the housing 5 will be launched at a velocity corresponding to the instantaneous rate at which the cable 1 is moving along the troughs 7 and 9. The housing 5 slides along the trough 11 at this velocity and moves into the trough 7 where it meets the engine 6. The housing 5 passes through the engine 6 without any interruption of the cable-laying process, as was described above. It then travels along the trough 9 and slides down the overboarding chute 10 into the water.

After the housing 5 has been launched in this manner, the catapult launching apparatus is placed in condition for launching another housing 5. This is accomplished by manually moving the pivot arms 67 outward and then manually pushing the carriage 14 back along the rails 13 so that the ring 62, which is attached to the upright end 64 of the carriage 14, forces the coiled spring 15 back into its compressed position. During this time, the ring 62 will have passed through the rotatable ring 54 and will be in the position shown in the drawing. The trigger 17 is then manually pulled downward thereby rotating the ring 54 to which it is attached. This moves the recessions 69 away from the pivot arms 67 which move inward to their positions shown in the drawing. The trigger 17 and the ring 54 are now held in this position by the force exerted by the spring 58. A loop of the cable 1 is next passed through the guard frame 59 and is slipped under the trigger 17. Another housing 5 is taken from the stowage rack 4 and is placed on the launching carriage 14.

The portions of the cable 1 extending between this housing 5 and the stowage tank 2 are then adjusted to provide sufficient slack for the launching operation. The equipment is now in proper condition preparatory to the launching of this housing 5.

What is claimed is:

1. A variable velocity spring catapult mechanism comprising a carriage, trigger mechanism for normally holding said carriage in a retracted position, a spring associated with said carriage, means for compressing said spring while said carriage is held in its retracted position, means for releasing said trigger mechanism whereby to permit projection of said carriage by said compressed spring, and means for varying the action of said compressing means whereby to correspondingly vary from time to time the degree of compression of said spring.

2. A variable velocity spring catapult comprising a spring, holding means for holding a first portion of said spring in a fixed position, means for applying pressure to another portion of said spring for storing a propulsive force in said spring, trigger means for operating said holding means for releasing said first portion of said spring, a movable object mounted in proximity to said spring for receiving the impact of said propulsive force when released, and control means for changing the pressure applied to said said spring by said pressure means for varying the amount of propulsive force stored in said spring.

3. A variable velocity spring catapult comprising a coil helical spring, holding means adapted for normally holding the front end of said spring in a fixed position, instrumentalities for storing a propulsive force in said spring, said instrumentalities including pressure means for applying pressure to the rear end of said spring for compressing said spring, means for releasing said propulsive force stored in said spring, said means comprising trigger means for operating said holding means for releasing said front end of said spring, a movable object placed in proximity to the front end of said spring for receiving the impact of said propulsive force of said spring when said front end is released, and control means for varying the instantaneous propulsive force stored in said spring, said control means comprising means for alternately increasing and decreasing the pressure applied to said spring by said pressure means.

4. A variable velocity spring catapult comprising a coiled helical spring adapted to provide a propulsive force, a movable instrumentality adapted for receiving said propulsive force and for being impelled thereby, holding means for normally holding said instrumentality fixedly in abutment against the front end of said spring, releasing means for operating said holding means for releasing said instrumentality for propulsion by said force, a movable plunger mounted in abutment against the rear end of said spring, said plunger being adapted to apply pressure to said spring for effecting its compression for producing said propulsive force, and control means for varying the amount of said propulsive force from time to time, said control means including means for progressively forcing said plunger further against said rear end of said spring for progressively increasing the degree of compression of said spring, and said control means also including other means for gradually reducing the pressure exerted by said plunger against said spring for gradually reducing the degree of compression of said spring.

5. A variable velocity spring catapult for producing a variable propulsive force through variable compression of its coils, a projectile adapted to receive said propulsive force, holding means for normally fixedly holding said projectile against the front end of said spring, releasing means for operating said holding means for releasing said projectile for projection by said spring, pressure means adapted to apply pressure to said spring for effecting its compression for producing said propulsive force, said pressure means comprising a chamber having

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fluid therein, a piston slidably mounted for movement in and out of said chamber, said piston having its head contained within said fluid chamber and having its other end located outside said chamber and in abutment against the rear end of said spring for applying pressure thereto, means for deriving a voltage proportional to the instantaneous fluid pressure in said chamber, and control means for utilizing said voltage for alternatively increasing and decreasing the amount of fluid in said chamber for varying the fluid pressure applied to said piston and thence to said spring.

6. A variable velocity spring catapult adapted for propelling a housing connected integrally in a cable that is being payed out at a rate which varies from time to time, said catapult comprising a coiled helical spring, holding means for normally holding the front end of said spring in a fixed position, pressure means for applying pressure to the rear end of said spring for compressing said spring for storing a propulsive force in said spring, said pressure means including a chamber having fluid therein for producing fluid pressure, means for applying said fluid pressure to said rear end of said spring, releasing means for releasing the propulsive force stored in said spring, said releasing means including a trigger for operating said holding means for releasing said front end of said spring, said trigger being adapted to be operated by a loop in a cable that is being payed out, the carriage adapted to hold a housing connected in the cable, said carriage being normally placed in proximity to the front end of said spring for receiving the impetus of said propulsive force when released, means for deriving a voltage proportional to the instantaneous velocity at which the cable is being payed out, means for deriving a voltage proportional to the instantaneous pressure of said fluid, control means for continuously utilizing both of said voltages for varying said fluid pressure in accordance with variations in the pay-out velocity of the cable.

7. A variable velocity spring catapult adapted for use with a cable-handling engine engaged in paying out at velocities which vary from time to time cable having housings connected therein at spaced intervals, said catapult having means for launching a housing at a velocity corresponding to the instantaneous cable pay-out velocity, said means including instrumentalities for imparting a propulsive impetus to a housing that is to be launched, said instrumentalities including a compressible spring,

pressure means for applying compressive force to said spring, and control means for varying said compressive force from time to time in accordance with variations in the cable pay-out velocity.

8. A variable velocity spring catapult adapted for use with a cable-handling engine engaged in paying out at velocities which vary from time to time cable having housings connected therein at spaced intervals, said catapult having means for launching a housing at a velocity corresponding to the instantaneous cable payout velocity, said means including instrumentalities for imparting a propulsive impetus to a housing that is to be launched, said instrumentalities including a compressible spring, pressure means for applying compressive force to said spring, and control means for continuously controlling said compressive force as a function of the cable pay-out velocity, said control means comprising means for deriving a voltage proportional to the instantaneous cable pay-out velocity, means for deriving a voltage proportional to the instantaneous compressive force, and means for adjusting said compressive force for establishing an equilibrium between said voltages.

9. A variable velocity spring catapult adapted for use with a cable-handling engine engaged in paying out at velocities which vary from time to time cable having housing connected therein at spaced intervals, said catapult having means for launching a housing at a velocity corresponding to the instantaneous cable pay-out velocity, said means including instrumentalities for imparting a propulsive impetus to a housing that is to be launched, said instrumentalities including a compressible spring, pressure means for applying compressive force to said spring, control means for maintaining a linear correlation between said compressive force and the cable pay-out velocity, and means for releasing said compressive force for launching a housing, said last-mentioned means including a movable trigger for receiving thereon a loop of that portion of the cable extending between the cable-handling engine and the housing that is to be launched, said trigger being adapted to be operated by said loop when said cable portion is payed out.

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