Sept. 6, 1949. C. B. DALE 2,481,004

WIRE RECORDER

Filed June 19, 1947

Fig. 1.

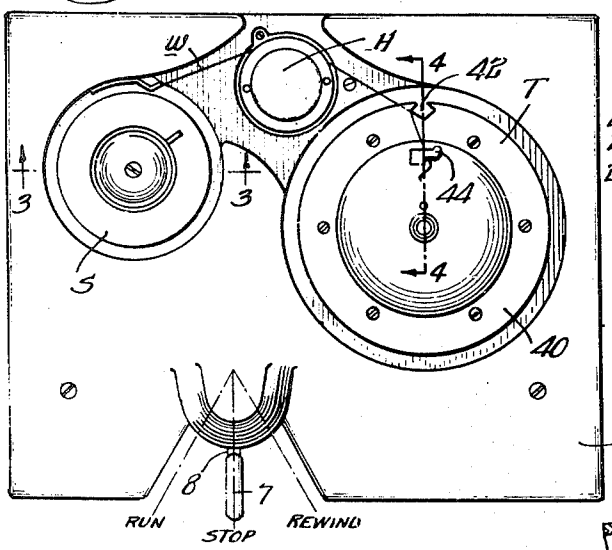


Fig. 3.

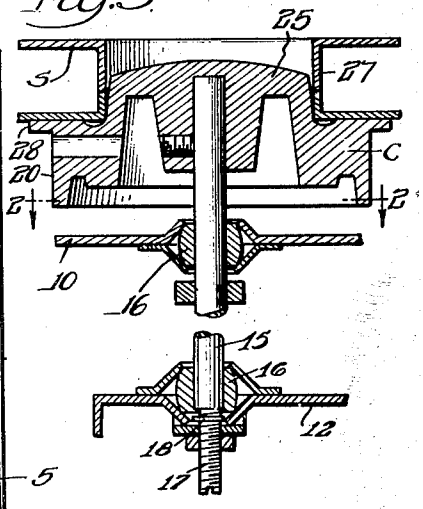


Fig. 4.

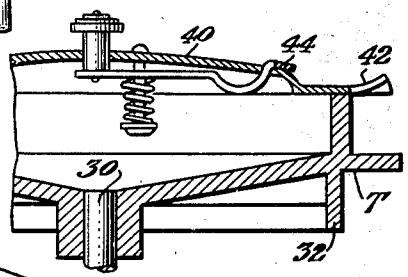
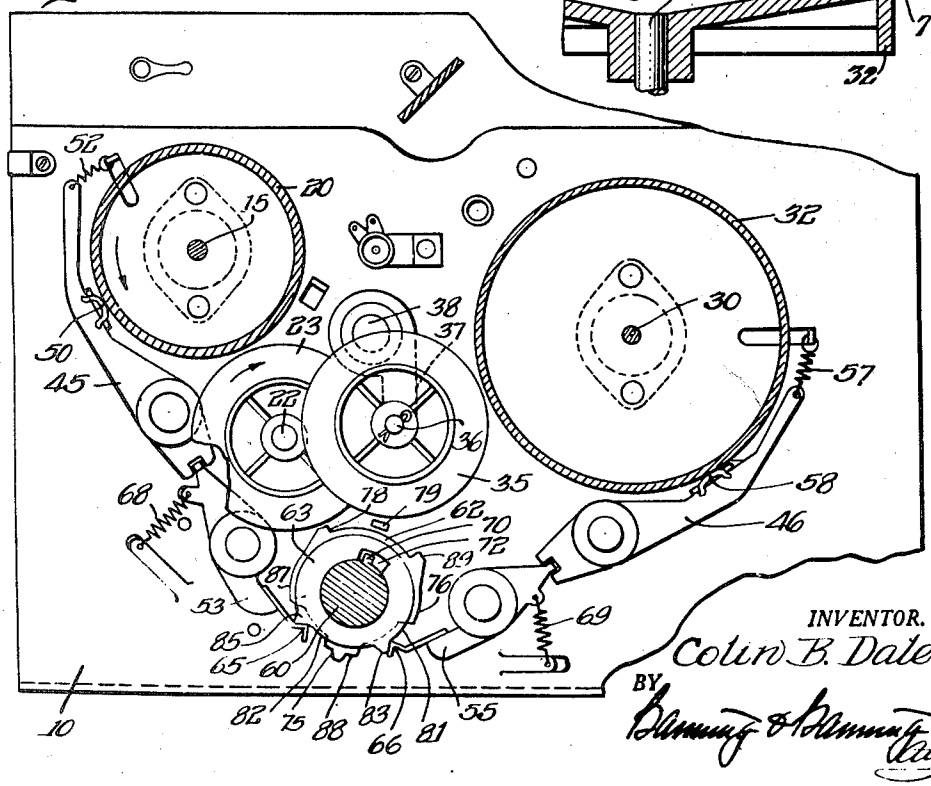


Fig. 2.



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UNITED STATES PATENT OFFICE

2,481,004

WIRE RECORDER

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Application June 19, 1947, Serial No. 755,695

6 Claims. (Cl. 242—54)

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This invention relates to a sound recording and reproducing machine utilizing a magnetizable medium such as steel wire, tape, or other material which is capable of being magnetized. Instruments of this type are commonly spoken of as wire recorders, and will be so referred to here.

A primary object of my invention is to provide means which will assure for the wire a taut condition which is substantially uniform at all times. Such a means involves a special mounting for a supply spool from which wire is drawn onto a takeup spool to be wound thereupon. The mounting for this purpose should include also means whereby to impart to the spool a relatively high speed of rotation whenever the wire, after being transferred to the takeup spool, is to be rewound back onto the supply spool.

In providing for a constantly taut condition of the wire, it may be desirable to co-relate the spool mounting with a braking mechanism which will operate with light and heavy pressures upon the spools for the wire supply and the takeup, depending upon the requirements of the moment. This is important both to assure level and even windings (in conjunction with a level winding device), and to prevent over-running of one spool with respect to the other. The spool mounting herein to be described serves also as an element in the transmission whereby the supply spool is driven. In such a transmission I utilize a constant speed motor in connection with a continuously running friction wheel which, while maintaining its operative relation with the motor, is movable into and out of contact with a drum that is part of the spool mounting so as to make or break a driving connection therewith. Since the operating speed of the supply spool, when driven, is perhaps seven times that of the take-up spool, it is apparent that each time such a driving connection is established the wire attached to the spool will be subjected to a sharp and sudden jerk, and likewise with each breaking of the driving connection, accompanied by application of a heavy braking pressure to the spool, the wire will again be subjected to a severe tensioning. The mechanism of this invention aims to prevent the development of such a condition, thereby to safeguard the wire against mechanical strains which might prove unsafe or disruptive.

As a suggestive embodiment of the present invention, reference may be had to the accompanying drawing wherein:

Figure 1 is a top plan view of the cover plate and exposed spools that may form part of a wire recorder as now commercially produced;

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Fig. 2 is a horizontal section, looking down from a plane that is immediately below the cover plate;

Fig. 3 is in enlarged vertical section through the supply spool and mounting therefor, taken on line 3—3 of Fig. 1; and

Fig. 4 is a detail in vertical section, taken on line 4—4 of Fig. 1.

In the wire recorder herein illustrated use is made of a cover plate 5 which extends over the instrument, the plate being appropriately recessed to accommodate a wire supply spool S, a pickup head H, and a wire takeup spool T. The pickup head is desirably associated with a level winder (not shown) so as to guide the wire *w* for even laying in its movements from one spool to the other. Operation of the entire mechanism is controlled by the handle 7 of a control lever 8 that is part of the run-stop-rewind switch (not shown).

The framework of the machine includes a base plate 10 and a sub-base plate 12 which support the wire handling means and associated mechanism. The electronic section of the apparatus, including the amplifier and power pack, may be mounted on a chassis (not shown) below the cover plate 5.

The wire supply spool S that is to be used in the machine is mounted on a chuck C, carried by a vertical shaft 15 that is journaled in self-aligning bearings 16 carried by the base plates 10 and 12. An adjusting screw 17 at the base of the shaft 15 provides for regulation in the height of the chuck C. A disc 18 of anti-friction material, such as Bakelite, is interposed between the screw 17 and the end of the shaft to afford a thrust bearing for the latter.

The chuck C is formed with a depending skirt or drum 20 that is concentric with the shaft 15. For operating the chuck I provide a single speed motor (not shown) having a shaft 22 which projects upwardly through an opening in the base plate 10. A friction wheel 23 is fastened on the shaft 22 near its top end. The tread of the friction wheel 23 is normally in engagement with the drum 20 of the chuck C. Under these conditions the chuck and the supply spool S carried thereby are rotated counterclockwise, as viewed in Fig. 2, in response to motion transmitted by the friction wheel 23. When the control switch operated by the handle 7 is in either its "run" position or in its "stop" (neutral) position the motor is caused to move slightly, as by tilting, whereby to shift the friction wheel 23 out of contact with the drum 20. The details of the motor mounting form no part of this invention,

since they have already been disclosed fully in my pending application Serial No. 733,654, filed March 10, 1947.

Rising centrally from the chuck C is a hub 25 whose peripheral walls 27 are contoured to conform substantially with an arc that is struck from a furthermost opposite point in the plane of an outstanding annular base 28 that supports the spool S upon its lower face. The arrangement just described is one which greatly facilitates the insertion and removal of successive wire supply spools S, since it is not necessary to accurately align the axial opening through the spool with the hub 25, nor to assemble the spool on the hub in any particular angular relation. When fitted operatively onto the chuck hub, the entire surface area of one end of the spool is in frictional engagement with the base 28.

The wire takeup spool T, is secured on the upper end of a vertical shaft 30, which may be journaled in bearings that are carried by the base plates 10 and 12, the same as for the shaft 15 (see Fig. 3). The spool T has a depending skirt or drum 32 that is horizontally aligned with a friction wheel 35 which functions as an idler between the motor shaft 22 and the takeup spool T. The idler wheel 35 is rotatably mounted on a vertical stub shaft 36 carried by an arm or lever 37 fulcrumed on a pivot 38 that is fastened to the base plate 10. When the control switch of the machine is in running position, the upper end of the motor shaft 22 is caused to advance against the tread of the idler wheel 35 to urge the latter against the drum 32 of the takeup spool T. Because of the large diameter of this drum relative to that of its shaft 30, the takeup spool T rotates relatively slowly when it is driven by the motor, the wire speed under these conditions being about one-seventh of the wire speed when the chuck C is being driven by the friction wheel 23.

A circular cover plate 40 on the takeup spool T provides therefor an upper flange wherein is formed a small slot or notch 42. The leading end of the wire *w* is led from the supply spool S partially around the recording head H and is then passed into the notch 42 for insertion beneath a latching or clamping finger 44 which bears on the upper surface of the cover 40 (see Fig. 4).

The head H houses the coils for recording sound magnetically on the wire *w*, and for picking up the acoustic signal from the wire, depending upon whether the instrument is being operated to record or reproduce the sound. The head H also contains an erasing coil for demagnetizing the wire to clear it of any previous recording when the instrument is being operated for recording purposes, as is familiar to those skilled in the art. Inasmuch as these portions of the apparatus are conventional, a detailed description thereof is not included herein. A notch is provided in the head, as is usual, for reception of the wire *w* by which it is also guided in its movements between the supply and takeup spools.

One main objective of my invention is maintenance of the wire taut both moving and while stationary in the machine, and prevention of overrunning of either spool so as to prevent fouling or snarling of the wire. To this end, I have arranged a dual braking mechanism, operable through manipulation of the control handle 7, for selectively braking the chuck C and the takeup spool T. The braking means includes brake arms 45 and 46, pivotally mounted on the base plate 10, associated, respectively, with the chuck C and takeup spool T. The brake arm 45 carries a shoe 50 which may consist of a pad of friction material adapted to engage the drum 20 of the chuck C when the brake shoe 50 is released to the action of a spring 52. A lever 53 having a tongue-and-slot connection with the brake arm 45 is pivoted on the base plate 10. A similar lever 55 pivoted on the base plate is also in a tongue-and-slot connection with the second brake arm 46. A spring 57 tends to urge the brake arm 46 toward the drum 32 of the takeup spool T for bringing a shoe 58 on this arm into engagement with the drum 32.

The control lever 8 includes in its structure a cylindrical rotor 60, which carries two brake control cams 62 and 63. The brake control levers 53 and 55 are provided, respectively, with cam followers 65 and 66 that cooperate with the control cams 62 and 63, these cam followers being urged toward the peripheral portions of the cams by springs 68 and 69, respectively, acting upon the levers 53 and 55. Projecting from the rotor 60 is a lug or key 70 that fits in a corresponding slot or keyway in the cam 62 so as to lock one to the other for concurrent movement. The cam 63, however, is provided with a relatively wide slot 72 which receives the key 70 so as to afford a certain amount of lost motion, the purpose of which will be apparent in the succeeding description. The brake control cams 62 and 63 may assume four different positions relative to the cam followers 65 and 66, depending upon the setting of the control handle 7.

Considering the operation when the control handle is in its "run" position, the cam follower 65 then rests on a step 75 of the cam 62, while the cam follower 66 rides on a high portion 76 of the cam 62. As a result of this disposition of the cams and cam followers, the lever 55 and brake arm 46 are rocked to an extent sufficient to withdraw the brake shoe 58 from contact with the drum 32 of the takeup spool T. The lever 53 and brake arm 45 are so positioned that the brake shoe 50 is applied only lightly to the drum 20 of the supply spool chuck C. The movement of the control handle 7 to the left, for setting the control switch in "run" position, is limited by engagement of a lug 78 on the cam 62 with a stop 79 projecting upwardly from the base plate 10. The control lever 8 is impositively held in this position by the cam followers 65 and 66.

From the foregoing description it is apparent that when the machine is being used to record or reproduce, the chuck C from whose supply spool the wire is being drawn is braked only lightly. Hence, if the operation of the motor should be interrupted while the control switch is still set in running position, the momentum of the chuck C and its wire supply spool S is checked so that overrunning is prevented. The takeup spool T need not then be braked since the motor is coupled thereto for driving purposes.

To stop the operation of the wire handling means, the control handle 7 is moved into its neutral or stop position. Assuming that the handle has previously been in running position, it will then approach the neutral position from the left as viewed in Fig. 1. Because of the lost-motion connection between the rotor 60 and the cam 63, the cam 62 is advanced counterclockwise (as viewed in Fig. 2) relative to the cam 63; or in other words, the cam 63 lags the cam 62

by the amount of lost motion which occurs as the lug 70 travels within the slot 72.

As the cam 62 is advanced into the position shown in Fig. 2, the follower 66 rides off the high portion 76 of this cam and onto a somewhat lower portion 81 which forms a dwell on the cam 63. The term "high" and "low" in this connection refer to large and small radii, respectively. The cam follower 65 rides off the step 75 and drops into a relief or dwell 82 on the cam 63. Due to friction there is some tendency for the cam 62 to be carried along by the cam 63, but any such movement is checked when engagement takes place between the cam follower 66 and a slight rise 83 at the end of the dwell 81, and between the cam follower 65 and a rise 85 on the cam 63. The friction between the cams 62 and 63 can be made sufficiently small, such as by the use of lubricant, so that the cam 63 cannot be moved to overcome the spring pressures of the followers 65 and 66 unless positively actuated.

The result of disposing the parts as shown in Fig. 2 is that the brake arm 45, being entirely released to the action of the springs 52 and 68, advances the brake shoe 50 heavily against the chuck drum 20, while the brake shoe 58 is applied lightly to the takeup spool drum 32. In this operation the wire handling means is to be stopped after a run for recording or reproducing purposes. The chuck 20 therefore is stopped abruptly so that overrunning of the supply spool S from which the wire is drawn is thereby prevented. At the same time the takeup spool T, being lightly braked, has no tendency to reverse its spin when the wire is stopped.

When the control handle 7 is moved into its rewind position, the parts of the braking mechanism are differently disposed. The cam follower 65 then rides onto a high portion 87 of the cam 62, causing the brake shoe 50 to disengage from the chuck drum 20 which is then being driven counterclockwise to rewind the wire upon the supply spool S. The cam 63, being positively actuated by the lug 70, is moved counterclockwise so that the cam follower 66 rides off the rise 76 and onto a step 88 on the cam 62. This causes the brake shoe 58 to be applied lightly on the drum 32 for the takeup spool T, thereby to maintain the wire *w* under only slight tension as it is drawn off the takeup spool S, and to prevent any overspin of the takeup spool if slack should develop in the wire. The movement of the control lever 8 into the stop position may be limited by engagement of a lug 89 on the cam 62 with the stop 79.

To terminate or interrupt the rewind operation the control handle 7 is moved into the neutral or stop position wherein the cams 62 and 63 are caused to assume still another position. Here the cam 63 is moved with the cam 62 until the cam follower 65, which has moved off the high portion 87 of the cam 62 and onto the intermediate dwell 82 of the cam 63, engages the slight rise 85 at the end of this dwell, and the follower 66, which has moved off the step 88 and onto the low portion 82 of the cam 63, is disposed in proximity to the rise 83 on this cam. Consequently, the brake shoe 58 operating on the takeup spool T is applied heavily, while the brake shoe 50 which operates on the supply chuck C is applied only lightly. These brake settings (see Fig. 2) are the reverse of those which obtained when the control handle 7 was moved from the "run" to the "stop" position.

The operation of the machine in response to various settings of the switch control lever 8 may be summarized thus: (1) when in run position, the takeup spool T is being driven, there is no braking pressure applied to the drum 32, and only a light braking pressure is maintained on the chuck drum 20; (2) when in stop position after a run, a heavy breaking pressure is exerted on the chuck drum 20 and only a light pressure on the drum 32 of the takeup spool; (3) when in rewind position, the supply spool S is being driven, there is no braking pressure on the chuck drum 20 and only a light pressure on the drum 32 of the takeup spool; and finally (4) when in stop position after a rewind, a heavy braking pressure is applied to the drum 32 of the takeup spool, and only a light pressure on the chuck drum 20.

When a new wire supply spool is placed in the machine, the leading end of the wire *w* is drawn off the supply spool S and carried past the recording and reproducing head H to be attached by the latch 44 to the takeup spool T. It is preferable to manipulate the takeup spool by hand for bringing the head into its extreme upper position before the wire *w* is attached to the spool T, inasmuch as the wire commences to wind thereon from the top down. The wire feed is initiated by throwing the control handle 7 into running position at the left. The wire is wound evenly in uniform layers on the takeup spool T as the operation progresses. The wire feed may be started, stopped, and reversed as often as desired by manipulation of the control handle 7, the various working parts being automatically adjusted to each new condition. Reversal of the wire feed is accomplished by moving the control handle to "rewind" position.

To rewind the wire *w* the control handle is thrown to the right, to rewind position, and maintained there until all of the wire is drawn back onto the supply spool S. The rewinding operation takes place very rapidly, and as the last of the wire is withdrawn from the takeup spool T, the wire end is pulled free of the latch 44. The tug of the latch 44 on the wire produces a final and sharp tensioning of the wire, with the result that a portion of its outer coil is drawn inwardly between other coils on the supply spool S, whereby the wire at a point proximate to its projection from the spool is held securely against unwinding. The remaining length of the wire then is drawn onto the spool where it wraps loosely around the outermost layer. The end of the wire, as it slips away from the latch 44, is curled into a pigtail which prevents the end from accidentally being buried in the wire on the spool S, so that it can be readily located and manipulated when the spool is to be played back.

It will be noted that the motor shaft 22 remains in continuous operation. When motion is to be transmitted to the drum 20 whereby to rotate the supply spool S, the rotating friction wheel 23 is shifted into engagement with the stationary drum 20. Each friction wheel 23 and 35 is desirably rubber-treaded so as to enhance the value of the frictional drive imparted thereby. A characteristic of such a drive is the immediate transmission of full torque from the friction wheel to the chuck drum 20. If the spool S be so mounted on the chuck as to receive at one moment the full amount of the transmitted torque then the wire attached to the spool will be subjected to a severe mechanical strain. This applies to motion of the spool either way because the spool is started, either forward

or reverse, while the motor is operating at full speed. The excessive and severe strain to which the wire is subjected under such conditions may be harmful or disruptive in its effects.

It will be noted that by the braking mechanism hereinbefore described, provision is made for applying a light retarding pressure to the spool from which the wire is being unwound, and a heavy pressure thereto when rotation of the spool is to stop. By using a braking system of this kind, I prevent overunning of either spool. This is important not only to prevent snarling of the wire, but to maintain the wire in a uniformly taut condition at all times. To assist in achieving this objective without imposing severe strains upon the wire, I provide uopn the chuck C a mounting for the supply spool S such that the former will transmit rotation to the latter solely by the frictional connection that obtains therebetween. The value of the friction drive so established is ample to assure rotation of the spool at a predetermined speed, yet something less than that which obtains between the friction wheel **23** and either of the two drums **20** and **32** which it selectively engages. In the mechanism shown, the chuck is mounted at the top end of the vertical shaft **51** so that the spool S, when fitted over the chuck C is rested upon the base **28** of the chuck where it remains in gravity contact therewith. The result is that friction is at all times available to readily transmit motion from the chuck to the spool, or vice versa, with a diminishing safety slip at starting and stopping periods but without relative motion therebetween when the wire recorder is in normal operation. The moment that the chuck is first started in rotation, or that its direction of rotation is reversed, there is a brief interval of diminishing slipping at the point of spool transmission so as to minimize the strain upon the wire. The friction normally obtaining between the spool and chuck base is ample for transmitting a sufficient rotative force to assure winding of the wire *w* upon the spool at all times, and to assure a controlled unwinding of the wire therefrom.

I claim:

1. In a wire recorder, the combination of a wire supply spool, a wire takeup spool having a coaxial drum, each of the two spools being adapted to wind thereon a length of wire moving from one to the other, a rotatable chuck having a coaxial drum and adapted to support the wire supply spool for rotation coaxially therewith, a continuously rotating friction wheel adapted to establish or disestablish a full-torque driving connection selectively between itself and the chuck or the takeup spool whereby to drive the former at a peripheral speed several times that of the latter, a dual braking mechanism in connection with the drums of both the chuck and the takeup spools operable when the recorder is in normal speed operation to exert upon the driven drum no pressure while maintaining upon the other drum only a light pressure and, when decelerating to a stop, a light pressure upon the driven drum and a heavy pressure upon the other drum whereby to maintain a taut condition in the wire therebetween, and a frictional driving connection between the chuck and the wire supply spool of such value as to permit the latter to slip diminishingly relative to the chuck when the supply spool is accelerated or decelerated relative to the driving chuck whereby to protect the wire against excessive strain.

2. In a wire recorder, the combination of a wire supply spool, a wire takeup spool having a coaxial drum, each of the two spools being adapted to wind thereon a length of wire moving from one to the other, a rotatable chuck having a coaxial drum and adapted to support the wire supply spool coaxially therewith, a continuously rotating one-speed friction wheel adapted to selectively establish or disestablish a full-torque direct high-ratio driving connection between itself and the drum of the chuck or a full-torque indirect low-ratio driving connection between itself and the drum of the takeup spool, a dual braking mechanism for selectively applying a light pressure to the driven drum when the driving connection from the friction wheel is disestablished and, concurrently therewith, a heavy pressure to the other drum whereby to maintain taut the wire traveling either way from one spool to the other, and a frictional driving connection between the chuck and the wire supply spool of such value as to permit a diminishing slippage therebetween only when the chuck is caused by the friction wheel or by the braking mechanism to accelerate or decelerate from its normal speed of rotation.

3. In a wire recorder, the combination of a wire supply spool, a wire takeup spool having a coaxial drum, each of the two spools being adapted to wind thereon a length of wire moving from one to the other, a rotatable chuck having a coaxial drum and adapted to support the wire supply spool coaxially therewith, a continuously rotating one-speed friction wheel adapted to selectively establish or disestablish a full-torque direct high-ratio driving connection between itself and the drum of the chuck or a full-torque indirect low-ratio driving connection between itself and the drum of the takeup spool, a dual braking mechanism for applying selectively no pressure to the driven drum and only a light pressure to the other drum when the recorder is in normal operation, and, when decelerating to a stop, a light pressure upon the driven drum and a heavy pressure upon the other drum whereby to maintain the wire taut therebetween, and a frictional driving connection between the chuck and the wire supply spool of such value as to permit a diminishing slippage therebetween only when the chuck is caused by the friction wheel or by the braking mechanism to accelerate or decelerate from its normal speed operation.

4. In a wire recorder, the combination of a supply spool, a takeup spool having a coaxial drum, the two spools being adapted to wind thereon a length of wire moving from one to the other, a rotatable chuck having a coaxial drum and a base transverse to its axis of rotation adapted to support thereon in coaxial relation therewith the wire supply spool and engage therewith over substantially its entire area at an end thereof to provide a frictional driving connection therebetween, a continuously rotating one-speed friction wheel adapted to selectively establish or disestablish a full-torque direct high-ratio driving connection between itself and the drum of the chuck or a full-torque indirect low-ratio driving connection between itself and the drum of the takeup spool, and a braking mechanism operable with a variable pressure upon the two drums to prevent overrunning of either with respect to the other whereby to maintain the wire taut in its movement from one spool to the other and, under conditions of acceleration and deceleration thereof, imposing thereon a lesser

and greater resistance, respectively, than the value of the frictional drive between the chuck and the supply spool.

5. In a wire recorder, the combination of a supply spool, a takeup spool having a coaxial drum, the two spools being adapted to wind thereon a length of wire moving from one to the other, a rotatable chuck having a coaxial drum and a base transverse to its axis of rotation adapted to support thereon in coaxial relation therewith the wire supply spool and engage therewith over substantially its entire area at an end thereof to provide a frictional driving connection therebetween, a continuously rotating one-speed friction wheel adapted to selectively establish or disestablish a full-torque direct driving connection between itself and the chuck or an indirect driving connection between itself and the takeup spool whereby to drive the former at a peripheral speed several times that of the latter, and a dual braking mechanism operable with a variable pressure upon the two drums to prevent overrunning of either with respect to the other whereby to maintain the wire taut in its movement from one spool to the other and, under conditions of acceleration and deceleration thereof, imposing thereon a lesser or greater resistance, respectively, than the torque value of the friction drive between the chuck and the supply spool.

6. In a wire recorder, the combination of a

supply spool, a takeup spool having a coaxial drum, each of the two spools being adapted to wind thereon a length of wire moving from one to the other, a rotatable chuck having a coaxial drum and a base transverse to its axis of rotation adapted to support thereon in coaxial relation therewith the wire supply spool and engage therewith to provide a frictional driving connection therebetween, and a continuously rotating one-speed friction wheel movable to selectively establish or disestablish a high-ratio driving connection with the drum of the chuck or a low-ratio driving connection with the drum of the takeup spool, the torque value of the driving connection between the friction wheel and the chuck drum being greater than the value of the friction drive between the chuck and the supply spool whereby the latter is free to slip diminishingly to protect the wire against excessive strains.

COLIN B. DALE.

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