METROVICK-LILLY PROTECTIVE SYSTEM

Metrosick-Lilly protective devices are of three types:—

**The type “C” Controller**, which gives the highest degree of protection and is used for high-speed winding and deep shafts.

**The type “D” Controller**, which is applied to moderate depths.

**The Simplex type Controller**, which is recommended only for low-speed winding from shallow depths or for haulage protection.

The spheres of application of the three types are outlined more specifically in Leaflets 747/12-1 et seq.

The principle of operation is the same for all types. A speed-indicating element consisting of a light ball governor, and a distance-measuring feature consisting of a dial or dials carrying suitably profiled cams, have their action co-ordinated to operate a floating mechanism which, in its extreme position, opens a lightly-poised switch connected in a low-voltage safety circuit. The “C” and “D” types have separate forward and reverse overwind limit switches, also connected in the safety circuit, but on the Simplex model one switch is made to serve for all purposes. The opening of the safety circuit results in the tripping of a master switch which de-energises an electro-magnet or magnets to cut off the power supply and release the brake controls.

The general scheme of protection will be readily followed from the pictorial diagrams.

Fig. 1 (on page two) shows the scheme for an electric winder with alternating current motor drive. Fig. 2 (on page three) that for an electric winder with Ward-Leonard control and Fig. 3 (on page four) that for a steam-driven winding engine.
Fig. 1.—Schematic Diagram for the protection of an Electric Winder.
Fig. 2. Schematic Diagram for the protection of an Electric Winder with Ward-Leonard Control.
Fig. 3.—Schematic Diagram for the protection of a Steam-driven Winder.
Referring to the A.C. Electric Winder Diagram—Fig. 1—it will be noted that the emergency, overwind and overspeed trips are connected in series with the no-volt coil of the main circuit-breaker, the opening of which cuts off the supply to the auxiliary transformer and de-energises the magnetic brake latch, causing application of the brakes. A no-volt no-close device is fitted on the main circuit-breaker, and until the under-voltage release coil has been re-energised by placing the driver’s brake lever in the “On” position and returning the electric control lever to the “Off” position the circuit-breaker is locked out. When the main switch is closed auxiliary contacts on the main switch also close, thus short-circuiting the control lever interlock switches.

In the event of a trip-out occurring due to the opening of one of the overwind limit switches the control lever interlock switches first have to be closed by restoring the levers to their safe position, and the overwind limit switch which has operated must be short-circuited by depressing the foot-operated backing-out switch situated on the driver’s platform; the main switch can then be closed and the magnetic brake latch re-energised, with the brake lever still in the “On” position. The driver is then free to apply power to the winder motor, but only in the opposite direction to that in which the overwind occurred, the interlocking arrangements being such that any attempt to apply power in the other direction is defeated by the immediate re-opening of the main switch before the control lever has moved a sufficient distance to operate the reversing switch and apply power to the winder motor. The backing-out switch must be held closed by the driver’s foot until the over-wind has been corrected and the overwind limit switch on the Lilly controller allowed to reclose.

The protective system for Ward-Leonard electric winders—Fig. 2—is generally similar to that for a.c. control, the main difference being in that the safety trip switches are connected in series with the operating coil of a contactor in the exciter field circuit, the opening of which results in the de-energising of the brake trip latch, and of the winder motor.

The protective system for steam winding engines—Fig. 3—is generally similar to that for electric winders, the control levers all being provided with positional interlocks to ensure that the proper sequence of operations is followed in restoring the power supply after a shut-down and to prevent restarting in the wrong direction after an overwind. The electric supply for the tripping and solenoid circuits is normally taken from the L.T. lighting mains—either a.c. or d.c.—but, if necessary, the supply can be obtained from an electric battery or a rectifier connected to the a.c. mains.

ARRANGEMENT OF CONTROLLER DRIVES

For a single-drum winding plant the drive to the Lilly controller is taken from the drum shaft or from any other point mechanically connected thereto—such as the depth indicator drive shaft or gear box—the essential thing being to provide a positive non-slipping drive of ample mechanical strength and of suitable gear ratio to produce a given rotational speed on the drive shaft of the controller when the winding drum is rotating at its normal full speed. The corresponding full speed of the drive shaft of the type ”C” controller is 81.5 r.p.m.

The general arrangement of the drive for a single drum is similar to that from the fixed drum illustrated on the left side of Fig. 4 on page seven.

For a double-drum winding plant having one drum clutched and the other permanently keyed to the drum shaft it is necessary to install either two separately-driven controllers—one for each drum—or, alternatively, a single controller of a special modified type having one cam dial driven from each drum. With the latter arrangement the shaft of the fixed drum (or equivalent point) is connected to the drive shaft of the controller from which the “fixed” dial of the controller, and the governor, are driven through standard internal gearing, while the drive from the clutched (loose) drum is taken to an external worm-reducing gear, the low-speed shaft of which is coupled to the other dial of the controller, which is mounted loosely on its shaft instead of being keyed thereto.

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The arrangement of the drives for the special "loose dial" controller is shown diagrammatically in Fig. 4, opposite, the controller being opened out to show both dials. The actual assembly of the controller with external gear box for the loose-dial drive is shown in elevation and plan in Fig. 5.

It will be noted that the loose dial follows exactly the movement of the loose drum, while the fixed dial follows the fixed drum; consequently, when the ropes are adjusted for level-changing, etc., the controller is automatically reset for the new levels. Where it is required to do single-drum unbalanced winding with the loose drum stationary, additional cams can be provided on the fixed dial to give retardation and overwind limit protection at the lower end of the wind.

On double-drum winding plants having both drums clutched, a separate controller is necessary for each drum and the arrangement of the drive is illustrated diagrammatically in Fig. 6. In actual practice the drives are usually brought out side-by-side from the inner ends of the drums and are common to the depth indicators and Lilly controllers, although, where reasonably practicable, the controllers should have entirely independent drives.

Each controller is permanently related to its drum so that the setting of the controllers automatically follows the drums and their relative displacements; complete protection is therefore always available for both ends of the wind when winding in balance, i.e., with both drums clutched in, between any levels, while, for single-drum unbalanced winding, protection is always afforded at the extreme ends of travel, i.e., at the lowest working level and the top landing. It is, of course, always possible to adjust the retarding and limit cams by hand to give full protection at both ends for single-drum unbalanced winding between any two levels.

ARRANGEMENT OF DRIVER'S MAN-SAFETY LEVERS

For Reduced-Speed Protection Only.—A single controller on a single-drum winder, arranged for giving only reduced-speed protection for men winding, requires only one man-safety lever for the driver's use as it is immaterial so far as the protective gear is concerned whether the right or left hand conveyance, or both, are being used for carrying men, and it is not necessary to differentiate between the two conveyances when giving the man-safety signal. Only one crank (M) and one signal switch, therefore, need be provided but if, as is usual, two cranks are fitted, the driver's man-safety lever can either be coupled up to one crank and the other inoperative, or a common pin supplied to link both cranks to the single operating connection.

The above also applies to double-drum winders with one drum fixed and one clutched, protected by one "loose dial" type controller.

One man-safety lever would also suffice for a double-drum plant having a separate controller for each drum, but for convenience in arranging the mechanical connections it is usual to provide one man-safety lever for each controller.

For Reduced-Speed Protection and/or Alteration of Travel Limits.—Where the man-safety gear is arranged to advance the cam dials in order to bring the retarding and overwind limit cams into operation at an earlier level, it is usual to provide two man-safety levers for the driver—one for each conveyance—as when one conveyance is at the men-landing level at the top (below the normal material-decking level), the other conveyance is a similar distance above the bottom landing and the advancement of the cams must be cancelled before the descending conveyance can be lowered to the bottom landing. Having reached this point it is necessary to bring the man-safety protection into operation for the next wind and if both dials were advanced the overwind limit switch corresponding to the top conveyance would be opened, thus preventing the restarting of the winder unless the driver keeps his foot on the backing out switch and cancels all overwind protection.
Fig. 4. - Arrangement of drives for single Loose Dial Controller showing Controller Dials opened out in diagrammatic manner.

Fig. 6. - Arrangement of drives for two separate Controllers from Two Drums, each with clutch.

Fig. 5. - Elevation and plan showing general arrangement of the Loose Dial Controller with external gear box for the loose dial drive.
The above applies equally to a single-drum winder with a single controller, and a double-drum plant with two controllers, the only difference being that with a single controller there is one safety lever for each cam dial and the cranks (M), therefore, operate independently of each other, whereas with a separate controller for each drum the two cranks on each controller are linked together and the man-safety levers advance both dials of their respective controllers simultaneously.

"TWO-LEVER" CONTROL

Metrovick winding engine control systems incorporate a patented arrangement of the control levers and mechanical connections known as the "Two-Lever" system. This system is shown diagrammatically in Fig. 7 and it will be seen that it enables the number of mechanical joints and bearings to be considerably reduced, thus eliminating a great deal of the time lag and friction which is unavoidable with other and more complex arrangements. Further, the use of unreliable mechanical catches or triggers in connection with the emergency tripping gear is obviated.

Referring to Fig. 7, lever 2 is the control lever which is connected through the rod 4 to the electric controller or steam throttle valve.

Lever 1 controls the operation of the brakes through the system of rods terminating at the valve 10 of the brake engine 11, 9 being the floating or "follow-up" gear. Suspended from the plunger of the solenoid 6 is a crosshead 7 which carries a rocking lever.

Under normal conditions the crosshead is held in the upper position and forms the fulcrum of the rocking lever so that if the lever 1 be pulled back the end A is elevated and B is depressed, the valve 10 allowing the brake engine piston to fall so that the brakes are applied; conversely, forward movement of the lever 1 results in the brakes being released.

If now an emergency trip occurs, the solenoid plunger is released and the crosshead 7 falls; the point A becomes the fulcrum and about this the rocking lever turns so that the end B falls to the stop 8 and the brakes are applied. If the supply to the solenoid were now restored the crosshead would be raised and the consequent operation of the valve would result in the release of the brakes. The interlock switch 3, however, prevents the completion of the solenoid circuit until the lever 1 is brought over to the "full on" position. The point B now becomes the fulcrum. A is raised and with it the crosshead so that when the solenoid is again energised no movement of the valve occurs and the brakes remain on until the driver resumes control and moves the lever 1.