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LIFTING, LOWERING AND HAULING

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FIG. 1.

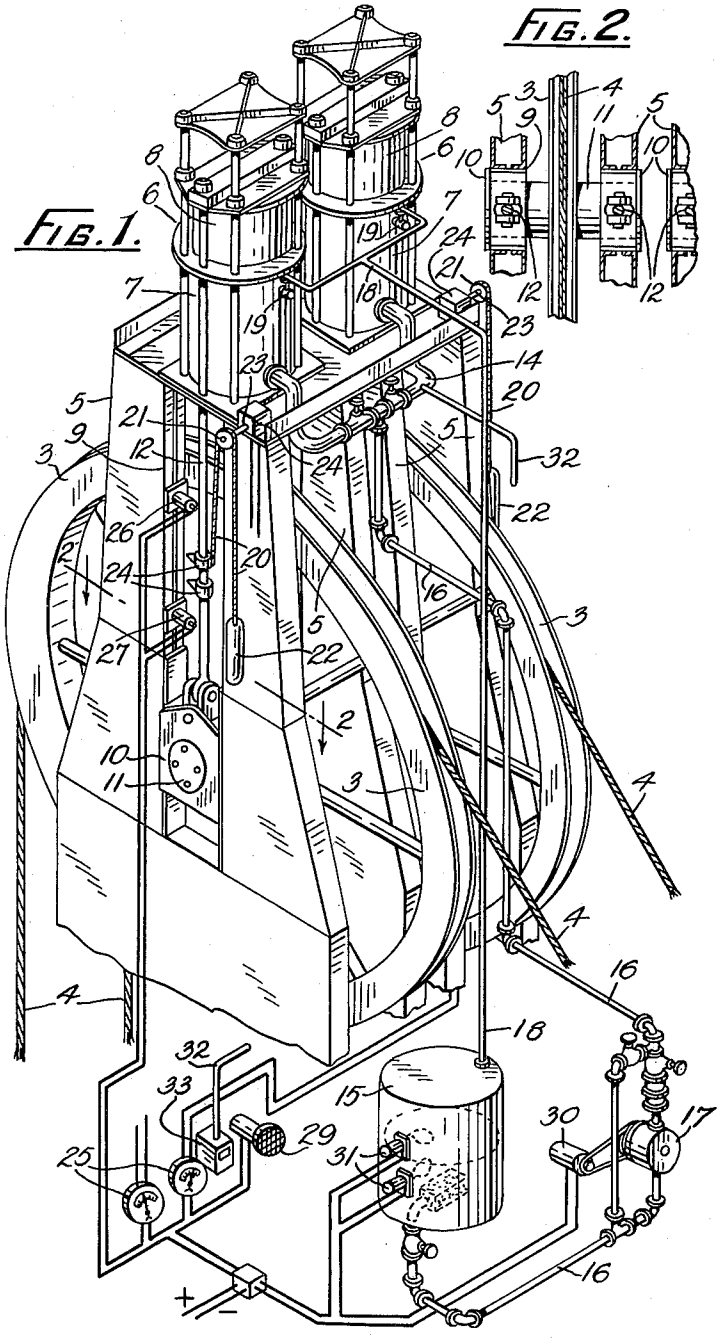

FIG. 2.

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LIFTING, LOWERING AND HAULING

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This invention relates exclusively to hoisting installations such as are employed in mine shafts wherein a single conveyance is supported by several ropes or cables. In these systems the multiple ropes may be wound around a single multi-compartmented drum or several drums; or they may be wrapped around a friction driving wheel, as in the Koepe winding system.

The use of multiple ropes imports the problem of equalizing the tensile forces on the several ropes. Differences in tension are apt to arise due to unintentional differences in the rope tread diameters of the drums or driving wheel, or to dissymmetry in rope coiling, when multiple layers are wound on to the drum, or to unequal stretch in the ropes.

On long winds small errors in rope tread diameter in manufacture, or due to uneven wear in service, can result in a tendency for the rope ends in multiple hoisting systems to become displaced by several feet. On the drum type hoist this could result in very serious mal-distribution of the rope tensions, but in the case of the friction hoist the effect is of equal importance since excessive rope creep over the sheave treads occurs throughout the winding cycle, which is the cause of severe and cumulative differential friction wear.

Devices have been proposed to compensate for unequal rope lengths, and the object of the present invention is to provide another such device with advantages as to effectiveness, simplicity and accessibility.

According to the present invention an automatic tension balancing means for ropes in multi-rope mine hoisting arrangements includes a direction changing sheave for each rope, an hydraulically operated ram for each sheave to move the sheave up and down and a closed hydraulic constant-volume system comprising the ram cylinders and conduiting interconnecting the cylinders.

Further according to the invention each ram is located above its associated sheave and a pair of arms straddle the sheave to couple the sheave shaft to the movable member of the ram.

On the other hand, the rams may be located below the sheaves.

Also according to the invention the shaft for each sheave is supported in bearings housed in cross-heads, coupled to the arms.

In the preferred form of the invention the apparatus includes means continuously to indicate the varying relative lengths of the ropes. There may also be provided protective means automatically operable when rope stretch exceeds a predetermined figure, to stop the apparatus or to give a warning signal.

According further to the invention a liquid reservoir is comprised within the hydraulic system together with a make-up pump, the reservoir receiving leakage from the rams and the pump returning liquid to the rams. In the preferred arrangement the operation of the pump is controlled by switching means adapted to be operated in accordance with the liquid level in the reservoir.

To illustrate the invention an example thereof is described below with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of the upper portion of a head gear incorporating a tension balancing means according to the invention, and

FIGURE 2 is a section on the line 2—2 of FIGURE 1 with parts broken away.

Each sheave 3 carries a rope 4 anchored to a common conveyance and the sheaves are supported between side frames 5. Collectively the side frames provide a platform for rams 6, each ram comprising a stationary cylinder 7 and a piston member 8 movable in the cylinder.

As shown in FIGURE 1 the side frames are slotted downwardly as shown at 9 to form guide ways for crossheads 10 housing bearings for the sheave shafts 11. Each crosshead is connected to a connecting rod 12 which passes upwardly to be coupled to the top of the piston member 8. Movement of the piston upwardly or downwardly in the cylinder 7 is used to impart a similar movement to the sheave through connecting rods 12.

The cylinders of the rams are part of a closed fluid system which includes conduiting 14 coupling the cylinders together. The system also includes an oil reservoir 15, piping 16 leading into the conduiting 14, a make-up pump 17 in pipe-line 16 and a gland leakage return pipe 18. Reference 19 indicates air escape valves or bleeders.

Provision is made for continuous observation of the behaviour of each rope. The means shown consists in a chain 20 attached to each rod 12, passing over a sprocket 21 and supporting a counterweight 22. The sprocket is mounted on a shaft 23 that drives a device such as a selsyn motor 24 which is connected to an indicator 25 that gives a direct reading of rope relative rope length. The two indicator sheaves, one for each rope 4, are located within the view of the driver of the hoist, so that he is at all times aware of the rope behaviour.

Additionally, protective means are provided to indicate when the stretch of any rope exceeds a predetermined figure. These means consist in a pair of limit switches 26, 27 for each sheave mounted on the side frames 5. Collars 24 mounted on the arms 12 are set to make contact with and actuate the switches when the sheave travel attains a preset maximum.

Actuation of the switch operates a warning device such as a siren 29.

The pump motor 30 is controlled by switching means 31 in the reservoir which are actuated by the level of oil therein. When the level of oil in the reservoir has risen to a predetermined upper level, due to the return of leakage through the pipe 18, the make-up pump is brought into operation to make-up the losses in the rams. The pump is of the positive displacement type and is brought to a standstill by the switching means 31 when the level has fallen to a predetermined lower level. By this means the amount of oil contained in the hydraulic system comprising the rams and the conduit 14 is maintained substantially constant.

In operation if the tension in, say, the left hand rope at any instant should exceed that in the right hand rope the tendency will be for the left hand rope to pull its associated piston member 8 downwardly in the cylinder 7. Simultaneously the flow of oil out of the left hand cylinder and into the right hand cylinder will act to lift the right hand piston upwardly until a balance of tensions is attained. This self balancing action is carried out automatically at all times.

An advantage of the apparatus described is that it provides a ready means to measure accurately, and integrate the net load hoisted in the convevance. In the drawings, the means to achieve this end consists in a branch pipe 32 from the hydraulic system, connected to an instrument 33 that measures liquid pressure in the system and integrates it directly in terms of the load lifted by the conveyance.

For simplicity of illustration two sheaves only are shown but the system may comprise three, four or any number of rope sheaves.

Many more embodiments exist each differing from the other in detail but in no way departing from the principle of the invention.

I claim:

1. An automatic tension balancing device for use on a multi-rope hoisting system comprising vertically mounted frame members, guideways vertically disposed in said frame members, crosshead members movably mounted in said guideways, sheaves rotatably mounted to said crosshead members for movement of ropes therein, a hydraulically operated ram connected to the crosshead members of each sheave to move each sheave within said guideways, first conduit means interconnecting each ram to maintain the level of hydraulic fluid therein, second conduit means interconnecting each ram to transfer fluid from one ram to another to automatically balance the tension between each sheave created thereon by its rope, and protective means connected to said frame members adjacent one of the guideways for each sheave to be automatically operable when position of any sheave changes a predetermined amount.

2. An automatic tension balancing device according to claim 1 in which each ram is mounted above its associated sheave, said ram comprising a cylinder having a movable piston therein, a pair of arms operably connected to and extending downwardly from said piston, each arm being connected to one of said crosshead members.

3. An automatic tension balancing device according to claim 1 in which said first conduit means includes a liquid reservoir to receive leakage from said rams, a make-up pump having one end connected to said reservoir and the other end connected to said second conduit means, and energizing means connected to said reservoir to automatically energize and de-energize said make-up pump in accordance with the level of fluid in said reservoir.

4. An automatic tension balancing device according to claim 1 in which said protective means comprises two limit switches mounted at spaced intervals on one of said frame members adjacent the guideway thereof, contact members being connected to the crosshead member of the guideway to actuate either one of said limit switches when the movement of the crosshead member exceeds a predetermined amount, and utilization means connected to and operable by the actuation of either one of said limit switches.

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