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A SHIPBOARD CABLE-HAULING SYSTEM FOR LARGE ELECTRICAL CABLES

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LARGE ELECTRICAL CABLES

by

F. R. Hess and L. V. Slabaugh

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J. B. Hersey, Chairman
Department of Geophysics
Finished cable puller installed on R/V Chain for International Indian Ocean Expedition.
ABSTRACT

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0.3 to 2.0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

INTRODUCTION

The increased use, during the past several years, of large electrical cable systems at sea has created a need for a new cable hauling system. Hydrophone arrays, towed magnetometers, geomagnetic-electrokinetographs (GEK) and other towed devices pose problems in retrieval, especially while underway. Their cables are often variable in length (i.e., consisting of removable sections) as well as in diameter. It is not practical, both for economic reasons and due to lack of space aboard ship, to provide separate winches for each cable system. Additionally, many of the cables, especially the larger ones, do not lend themselves to bending around small diameters such as capstans without the danger of permanent damage to the cable. While capstans of sufficient diameter to eliminate this problem exist, they are generally very slow, large, and much more powerful than necessary. Hauling the cables by hand is time-consuming.

The air-powered hauling system developed at the Woods Hole Oceanographic Institution (Fig. 1) solves these problems by providing a hauling machine sufficiently flexible to handle a wide range of cable sizes without damage. The hauling machine (Puller as it has come
THE PULLER

The Puller consists of three major assemblies: the base, the idler carriage, and the motor-drive carriage (Figs. 2 and 3).

Base

The base assembly is the pedestal containing the thrust and radial-load bearings. The pedestal may be swiveled in any horizontal direction so that the Puller can follow the changing lead of a cable as it is being pulled or locked by a clamp in any position. The entire base assembly is fabricated of stainless steel, because, although this material is expensive and difficult to work, it is the base of the unit that gets the most abuse. One-inch bolt holes are provided on 24-inch centers for mounting on the deck.

Idler Carriage

The idler wheel assembly, or lower carriage, is an aluminum box frame mounted on the swiveling platform at the top of the pedestal. It contains grooved idler wheels with integral ball bearings in their hubs. Mounted on the outside of the box frame are the filter-lubricator, air-supply hose connections, air gauge, reel-motor valve, cable-guide rollers, two lift cylinders, and lift-cylinder valve.

The filter-lubricator cleans the air supply and injects a continuous spray of oil into the air system. The oil mist is essential for proper operation of both the lift cylinders and the air motor, as it continuously lubricates and provides a rust-preventing coating to all the working parts of the air system.

Hose connections are provided for connection to the ship's air supply and to the reel motor (or other auxiliary device). A gauge is provided for monitoring the line pressure.
A double-acting spool valve is mounted on an extension at the rear, or inboard, end of the Puller. It controls the two lifting air cylinders on the idler frame. The cylinders are a small double-acting type used originally in aircraft; almost any small double-acting air cylinders capable of exerting about 100 lbs. of force will suffice.

Two rod guides with nylon bushings constitute the slide bearings for the motor-and-drive carriage above and are aligned with two corresponding guides on that carriage. They carry 1.25-inch stainless-steel shafts upon which the upper carriage rides.

Motor-and-Drive Carriage

The upper unit, the motor-and-drive carriage, carries the driving motor, chain drive, driving wheels, and throttle valve. It is supported on two guides, identical with those on the idler carriage, and can be raised and lowered on the sliding vertical shafts. The lifting and closing forces are provided by the air cylinders connecting the motor-and-drive carriage to the idler carriage.

The driving motor, a 3.5-horsepower gear-head air motor, drives the two pneumatic driving wheels through two lengths of 3/4-inch pitch, number 60, roller chain. For general use, all three sprockets are 19-tooth; when a greater pulling power is needed (with some sacrifice in speed), a 9-tooth sprocket is attached to the motor shaft in lieu of the 19-tooth one. The air motor is non-reversing (the cable would not push very well, anyway). The wheel bearings are a self-aligning type and are the only non-stainless-steel fittings on the machine.

The driving wheels are of a standard pneumatic type made for "go-karts". They are mounted on aluminum hubs keyed to the driven shafts. There are ports in the box frame for checking tire pressure.

The throttle valve is a variable-volume spool valve which is spring-loaded to the "off" position. This results in a "dead-man throttle" control.
Finish

The aluminum parts of the machine are protected from corrosion with an epoxy chemical-resistant paint. A primer and finish coat are used; the result is a hard, durable, and well-bonded coating which has resisted salt spray for several months with no evidence of corrosion. The stainless-steel base unit is not painted but is left in the original passivated-surface condition.

MOTOR-DRIVEN REEL

The motorized reel is an adaptation of a standard WHOI reel stand. An aluminum post, mounted on one side post, supports the motor. The motor is mounted on a small carriage block with two studs protruding to ride in the slots in the mounting post. Vertical adjustment, for the accommodation of various sizes of reels, is provided by a slot in the post.

The reeling motor is air-driven and supplied with air from the auxiliary outlet and valve on the Puller. This motor is intended not for pulling the cables, but only as a takeup device.

SYSTEM CHARACTERISTICS AND SPECIFICATIONS

Puller

Motor type: Ingersol-Rand 4800S vane-type air motor.

Motor rating: 3.5 hp at 145 rpm with 90 psi air supply (125 psi max.).

Max. cable pull: 480 lb. (with 19-tooth driving sprocket). 980 lb. (with 9-tooth driving sprocket).

Cable speed at max. pull: 225 ft/min.

Cable speed at no load (max.): 430 ft/min. (with 19-tooth sprocket).
Reeling motor

Motor type: Ingersol-Rand 1841U vane-type air motor.

Motor rating: 1.2 hp at 150 rpm with 90 psi air supply.

Motor free speed: 340 rpm.

Max. cable pull: 150 lb. for 4' diameter reel (varies as reel diameter).

PERFORMANCE

This cable-hauling system has proven itself during a period of more than six months at sea. During this time the only failure which occurred was a temporary freeze-up of the motor due to inadequate oil feed in the lubricator. The time saved and the relief from manual retrieval afforded the ship's party, have more than paid for the system.

The Puller has been called upon successfully to haul cables ranging from a .375-inch diameter GEK cables to a 2-inch manila hawsers (when the stern capstan on the ship had failed). There has been no cable slippage even with wet rubber or plastic sheathed cables. When the base clamp of the Puller is released it will follow the lead of the cable being pulled with no control by the operator.

A complete set of mechanical drawings of the system is available on request from the authors.
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