

Description of the cable laying barge Henry P. Lading

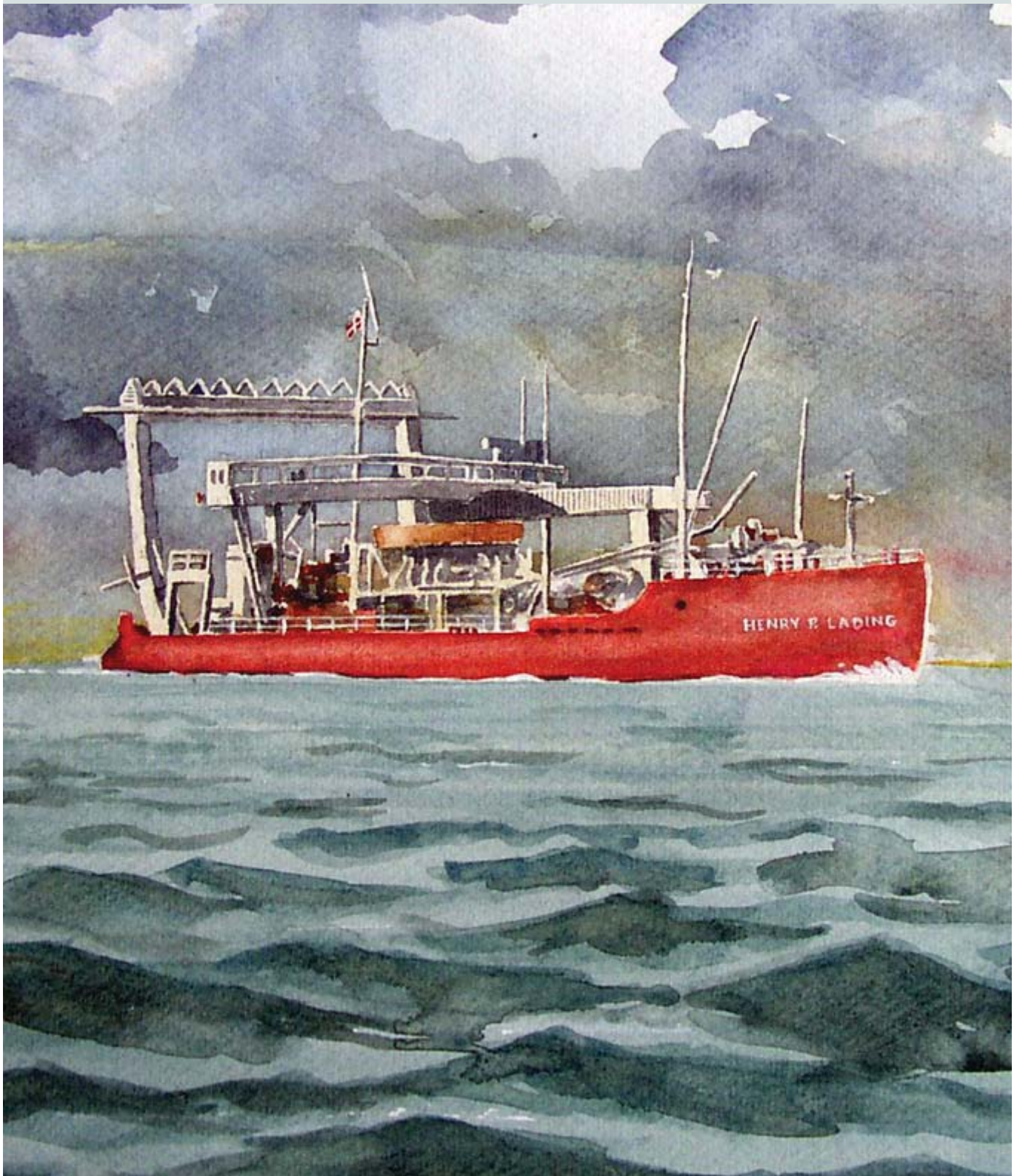


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Description of C/B Henry P. Lading

The biggest cable transport and laying vessel in JD-Contractor ApS' fleet is the transport and cable laying barge Henry P. Lading. When not in operation, it is moored at the quayside in Kalundborg - Denmark.

C/B Henry P.Lading is built as a pontoon without its own propulsion machinery and is equipped with an anchor winch, 4 warp winches and 2 capstan winches complete with anchors, chains and wires.



The most important equipment on board is the hydraulically operated laying capstan wheel and the big turntable with various tension devices and roller paths.

Furthermore, C/B Henry P. Lading is equipped with an echo sounder, equipment for angular measurement measuring the pull on the cable, and equipment for measuring the length of the cable laid out as well as navigation equipment. During the laying, all main data is monitored, logged and printed out for quality control.

For communication purposes C/B Henry P. Lading is equipped with one short and medium wave radio and four VHF radios. To secure correct and fast information for the crew C/B Henry P. Lading carries 18 portable VHF radios.

Type of vessel: Cable transport and laying vessel

Call sign:	OU8603	Height:	4.25 m
Length:	72 m	Capacity:	1700 t
Width:	21.3 m	A-frame: Free opening:	40 t 16 m
Depth:	4.3 m	Height over main deck	max. 12 m
Load draught, max.:	3.4 m	One tackle:	30 t
Tonnage:	GT 1631 t NT 489 t	Two tackles apart from each other	40 t
Accommodation for:	25 people	4 warp winches: Max. pulling force:	8 t 8 t
Laying equipment:		Wire length:	1000 m
Capstan wheel	OD: 6 m	Wire dimension:	30 mm
Turntable	ID: 7.5 m OD: 19 m		

Loading and transport

From the quay by the cable factory the cables are wound directly onboard the turntable of C/B Henry P. Lading.

When the entire cable is onboard C/B Henry P. Lading, a tugboat of approx. 3700 IHP tows her, to the laying site. Towing speed is approx. 8-9 knots in good weather conditions.



Laying Preparation



Before starting the laying operation, the following preparations must be carried out:

- ▶ On shore beacons and other navigation outfits are established, if necessary.
- ▶ The position of the end connection point must carefully determined and correct co-ordinates provided.



- ▶ The trenches on the bottom and on shore must be ready.
- ▶ On the coast a powered winch or bulldozer for hauling in the cable is set up.

Alternatively, 3-6 hooks (eyes for the fastening of snatch blocks) must be placed.

At the hauling in of the cable a wire from a winch on shore is connected to the cable end.

The Laying



C/B Henry P. Lading is anchored by means of warps. The distance from coast corresponds to a water depth of approx. 4-6 m depending on the weather and bottom conditions.

The cable is hauled towards the shore floating on airbags by the workboat. Here the airbags are removed and the cable is pulled up onto the End Termination. The remaining airbags are removed and the cable sinks down into the trench monitored by divers.

C/B Henry P. Lading is now disconnected from her warps and the actual laying operation starts. With one tugboat ahead and one tugboat moored perpendicular to the side of the barge working as a thruster, and a third tug to the aft to stop the lay barge, the laying is carried out at a speed of 1-2 km per hour.

From the turntable, the cable goes via the tension regulator to the capstan wheel and through the bell mouth into the sea. During laying the length laid out, the laying speed, the pull in the cable as well as the water depth and the barge position are continuously measured and logged.

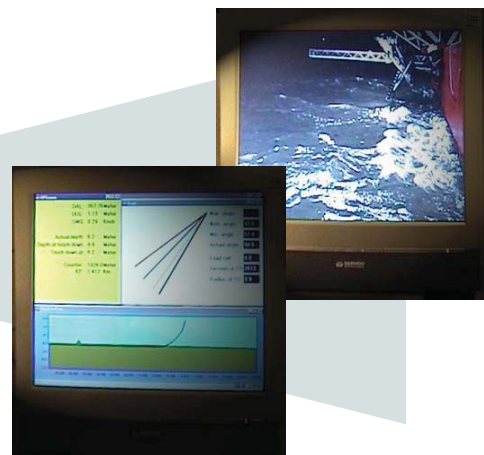
The pull on the cable corresponding to the actual water depth is calculated, shown on a screen and set-up in the form of a table and this information is stored.

Two operators on the bridge direct the laying. One operator adjusts the speed of the turntable so that the tension regulator (the accumulator) is always in medium position, the other operator adjusts the speed of the capstan wheel so that the pull corresponding to the water depth is established.

At a water depth of about 7 meters depending on configuration at the actual site, C/B Henry P. Lading is stopped and turned by means of warps and sails along the shore while the cable is brought afloat by means of airbags.

When the correct length is laid, the cable is cut and closed onboard the vessel and the workboat tows the cable to the shore. The powered winch or bulldozer on land now takes over the hauling in and the cable is pulled ashore until all slack is taken. Then the airbags are removed and divers control that the cable is placed correctly in the trench.

The laying as here described lasts one day for each cable under normal conditions assuming that the weather is suitable and all preparations are finished before the laying.



On the monitor the laying angle and the depth are shown.

Navigational Aids

Please note



The positioning system is optional, and installed each time to the clients specification as stated in the agreement between JD-Contractor ApS and the customer.

As Standard a DGPS system with echo sounder and a Gyro are installed, though C/B Henry P. Lading can be supplied with other equipment after the client's wishes.



In order to satisfy our customer's requirements for documentation, we use the latest equipment for the positioning and depth measurement of our laying systems. C/B Henry P. Lading can therefore be equipped with precise RTK DGPS positioning equipment, which is connected on-line to Navi Pac and can be installed with Track Point II and a depth sensor.

The system can communicate with our tugboats. This gives us the exact location of our ships and more importantly the cables. The system can be installed on all our vessels.

A description of how the laying of cables can be electronically monitored :

While laying the cables, C/B Henry P. Lading navigates by means of a RTK (Real Time Kinematic) DGPS (Differential Global Position System) navigation system; Ashtech or similar. See technical description on following pages.

A computer system calculates the co-ordinates and compares them with the actual cable route. The actual position and data are shown on the captain's/helmsman's display.

Furthermore, the computer successively copies the location of the lay barge so that the trace can be controlled after the laying. As a result, the client can receive an accurate image of the cable as laid.

▼ The Bridge:



The navigation system has separate graphic displays of navigational data for the helmsman and of all data and control functions for the surveyor. For the RTK DGPS navigation the Ashtech Z-Surveyor Receiver is used.

RTK DGPS positioning System

RTK DGPS is a positioning determination system based on the American satellite positioning system GPS (Global Positioning System).

The satellite signals for the required positioning accuracy cannot be obtained by using one GPS receiver only. DGPS is the designation of a so-called differential GPS .

A stationary land station (placed at a fix point) connected to a radio link transmits the correction signals to the mobile (e.g. located on a ship).

By use of the signals the mobile adjusts the distorted satellite signals, and a dynamic positioning accuracy of 5 to 10 centimetres is hereby obtained for the mobile.

The GPS calculates the position in the global, geographic co-ordinate system in WGS84. The calculated position is sent electronically to the Navipac system, which transforms the WGS84 co-ordinates to the local system. Navipac is a navigation program, which continuously calculates co-ordinates and stores data on a hard disk.

Standard Positioning Equipment	
Receiver:	DGPS - Ashtech GP2 The correction signal Differential from a public station
Gyro:	Sperry SR 50
Expander:	The computer is equipped with an 8-slot expander box for relevant interfacing purpose. Gyro. As Gyro is used a Sperry SR 50.
Echo sounder:	Navitronic Sounding 30
Helmsman's Display:	The RGB monitor is a remote display unit that provides the Helmsman with all information required to follow a track. The steering repeater instrument indicates left/right information, both analogue and digital.
Extra Positioning Equipment	
Primary Receiver:	Ashtech Z-Surveyor RTK (real time kinematic) DGPS (Global Positioning System)
Secondary Receiver:	DGPS - Ashtech GP2 The correction signal Differential from a public station (Secondary when using RTK)
Other tools:	Track point II and a depth sensor
Calibration	
	The total navigation system is checked by mooring the ship.
Software	
	On-Line Navigation - and Data Acquisition System.
	The proposed on-line software package is the "Navipac 2004" system, delivered by EIVA A/S.
	All heavy computer routines are compiled and all time consuming interface handlings are isolated in fast interrupt transfers. Therefore, the system can easily achieve a navigation cycle time of 2-3 seconds.
	All user-activated functions (parameter input, mode setting, etc.) are implemented in such a way that the system's primary tasks are kept running during input and execution of the functions.
Mass Storage Databases	The mass storage databases contain:
	- Geodetic parameters.
	- Station co-ordinates with antenna offsets, corrections (delay, calibration etc.)
	- Relative positions of transducers, etc.
	- Interface definitions.
	- System set-up for warm start facility.

RTK DGPS positioning System

Software (continued)	
Navigation:	Application of C-O corrections to LOPs. Least squares computation of position and quality of fix from any positioning system, using up to 15 LOPs.
	LOP may be range, bearing, hyperbolic or positional in geographical or UTM grid.
	LOPs can be switched on and off on-line at any time without causing disturbance to the survey task.
	A second order Kalman filter is incorporated for position prediction in order to reduce computational time spent in the position calculation. The filter has no effect on the quality of the position calculations, but is user selectable in function and depth.
Event Marks:	Time intervals using automatic event mark simultaneous output of event mark to remote recorders. Manual event marking is possible at any time.
	Recording on Hardcopy Printer.
A system set-up:	- Geodetic parameters
	- Station co-ordinates
	- Antenna and transducer offsets
	- Interface configuration
During laying process:	- Time and day
	- Run line and event numbers
	- Raw LOP values
	- Computed positions in rectangular co-ordinates
	- Root mean squared error of computation
	- Remote positions
	- Sensor/depth data
	System records when navigation starts and stops, etc. Graphic hardcopy of vessel's track from internal live graphic screen on request.
	Internal Screen (CRT)
Live graphic screen showing:	- UTM grid or National Grid (on request) at any scale
	- Defined run lines
	- Current positions (vessel and remote positions)
	- Event numbers
Nine alpha pages showing:	- Raw LOPs from positioning system
	- Gyro heading
	- Computed positions
	- RMSE of calculated position
	- Residuals to position line
	- Numbers of iterations
	- Marking parameters
	- Run line information
	- Along and across track information
	- Fixed and variable corrections constants
	- Recording status

RTK DGPS positioning System

Software (continued)

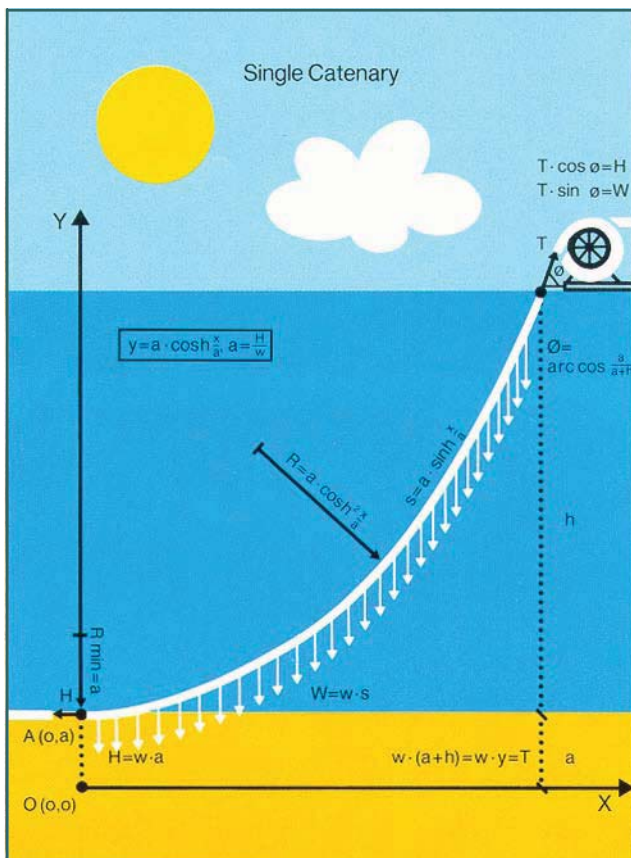
Helmsman's Display:	The remote display shows the following:
	- Left/right indicator
	- Easting
	- Northing
	- Distance off line
	- Distance along line
	- Distance to go
	- Speed
	- Depth
	- Cable Counter
	- The pull on the cable
	- Gyro
	- Survey line bearing
	- Course
Data Recording System:	Data recording on internal hard disk.
	At start of laying run line all selected stations, parameters, offsets and defined run line are recorded.
	For each computation cycle the following data are recorded:
	- Time
	- Raw data from LOPs (two systems in parallel)
	- Gyro heading
	- Computed co-ordinates
	- Data acquisition sensors
	- Corrected water depths (as specified and requested)
	On-Line Track Plotting
	The on-line system provides the following plots in real time:
	- Run line
	- Track plot of the vessel's reference point and/or - Track plot of remote position, as requested
	Scale and density of the plots are software selectable.



Tension in the Cable During Laying Operation



The laying method used by JD-Contractor ApS is to have the cable hanging in a catenary curve from C/B Henry P. Lading to the seabed.



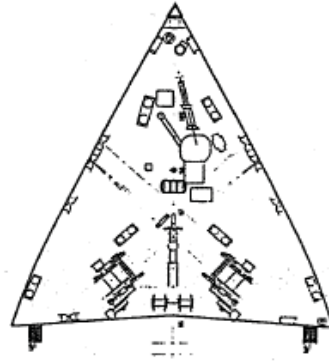
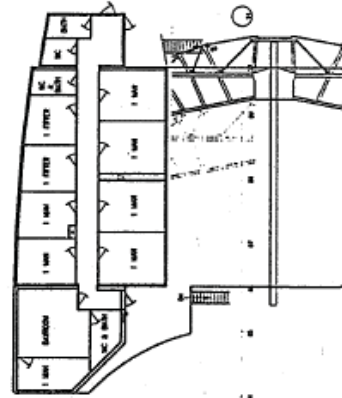
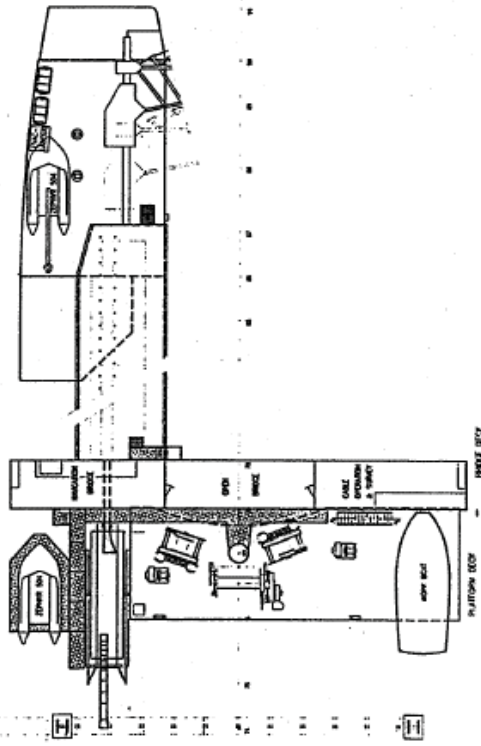
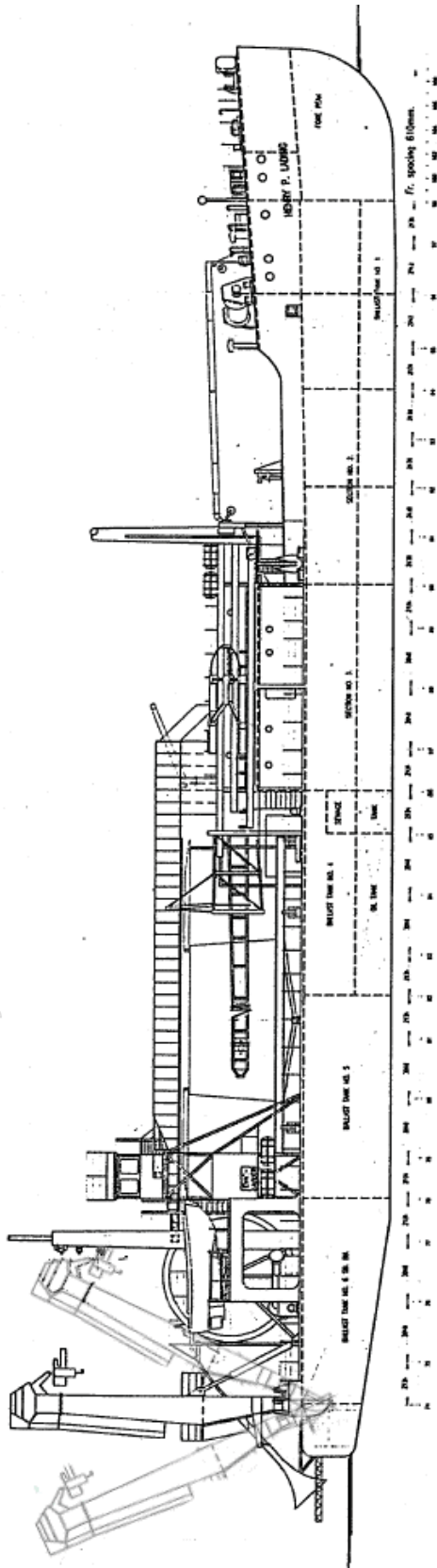
The tension in the cable at C/B Henry P. Lading can be calculated from:

$$T = h \times w + H$$

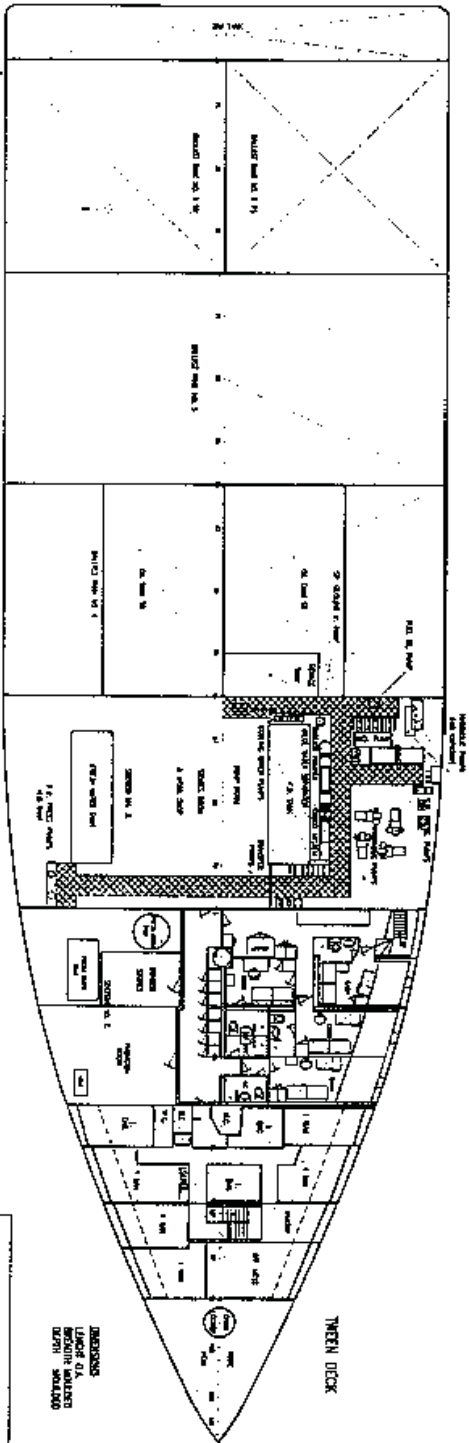
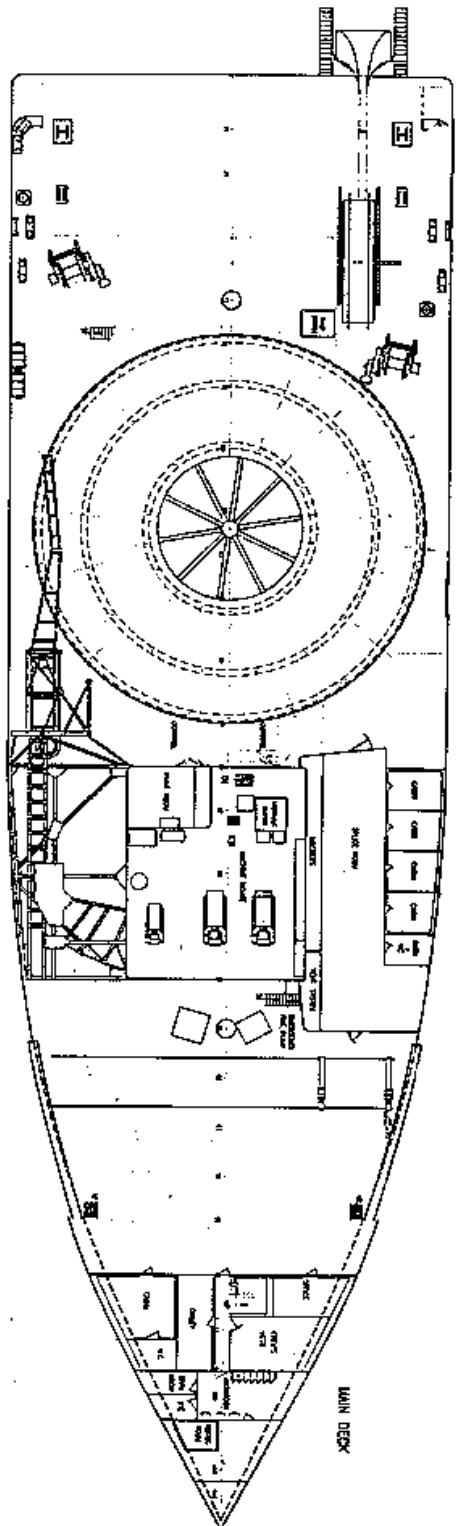
h is the water depth

Where **w** is the weight of the cable per unit length in seawater

For the actual laying operations, the normal surface tension in the cable will depend on the water depth.



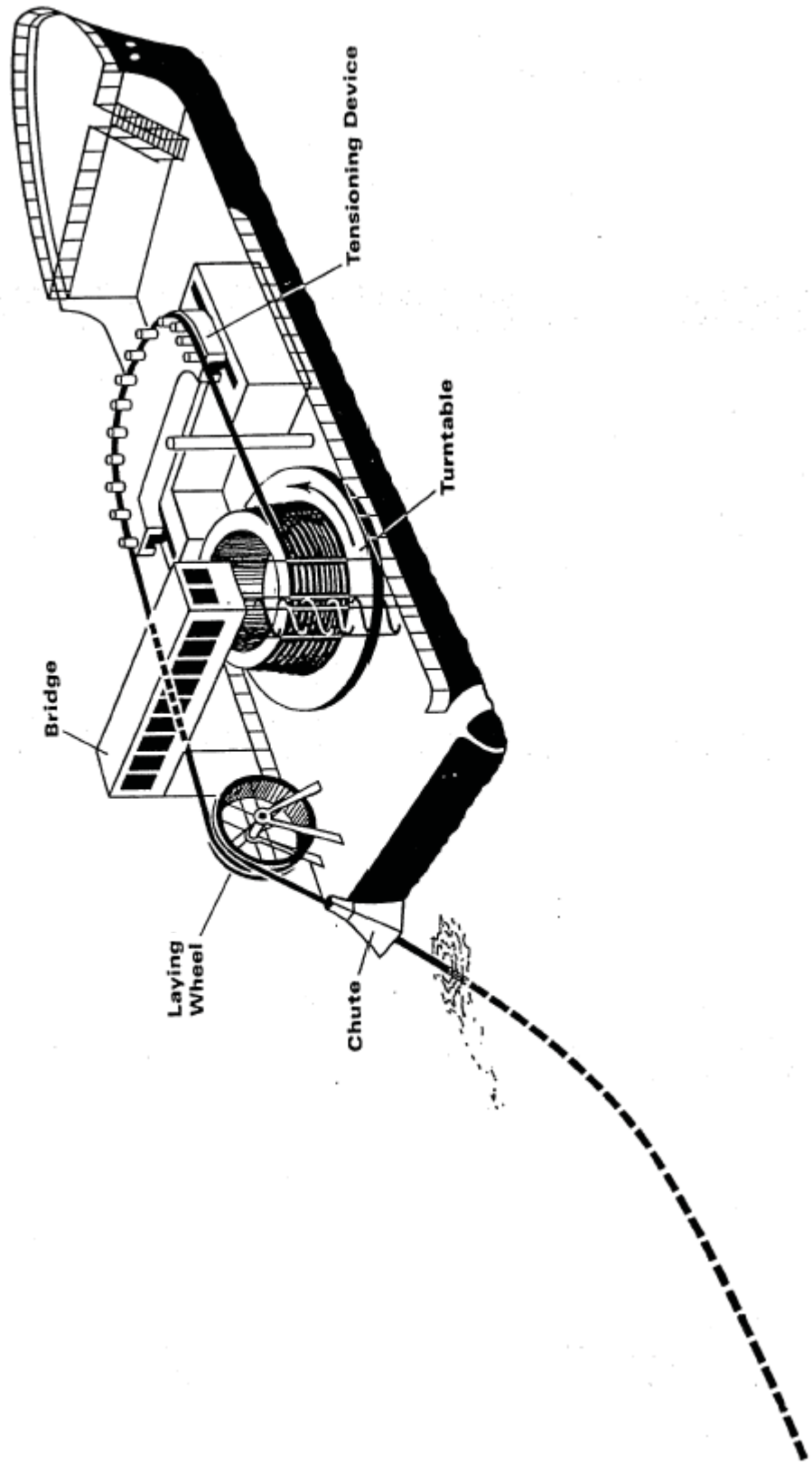
Project No. 1/200 ST03377-109-01	Date: 1/200 Scale: 1/200 Drawing No. 1/200
HENRY P. LADING GENERAL ARRANGEMENT 1/2	
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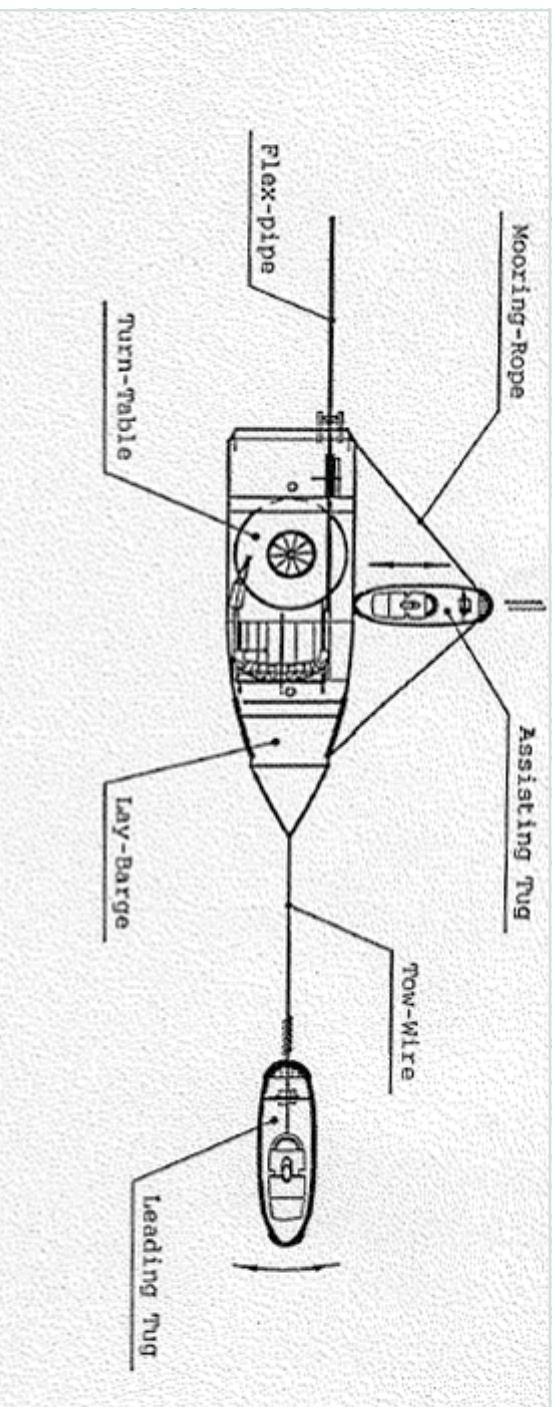
DIMENSIONS
 LENGTH 61.4
 WIDTH 10.4
 DEPTH 3.0
 71.51' L
 24.28' W
 10.50' D

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HENRY P. LOUIS	
THE APPOINTMENT 2/2	
Shiptec	

Schematic diagram showing position of cable



Schematic diagram showing C/B Henry P. Lading in its laying position



The tugboat to the aft is not showed on the sketch