IFP-IHC Unicode heave compensator

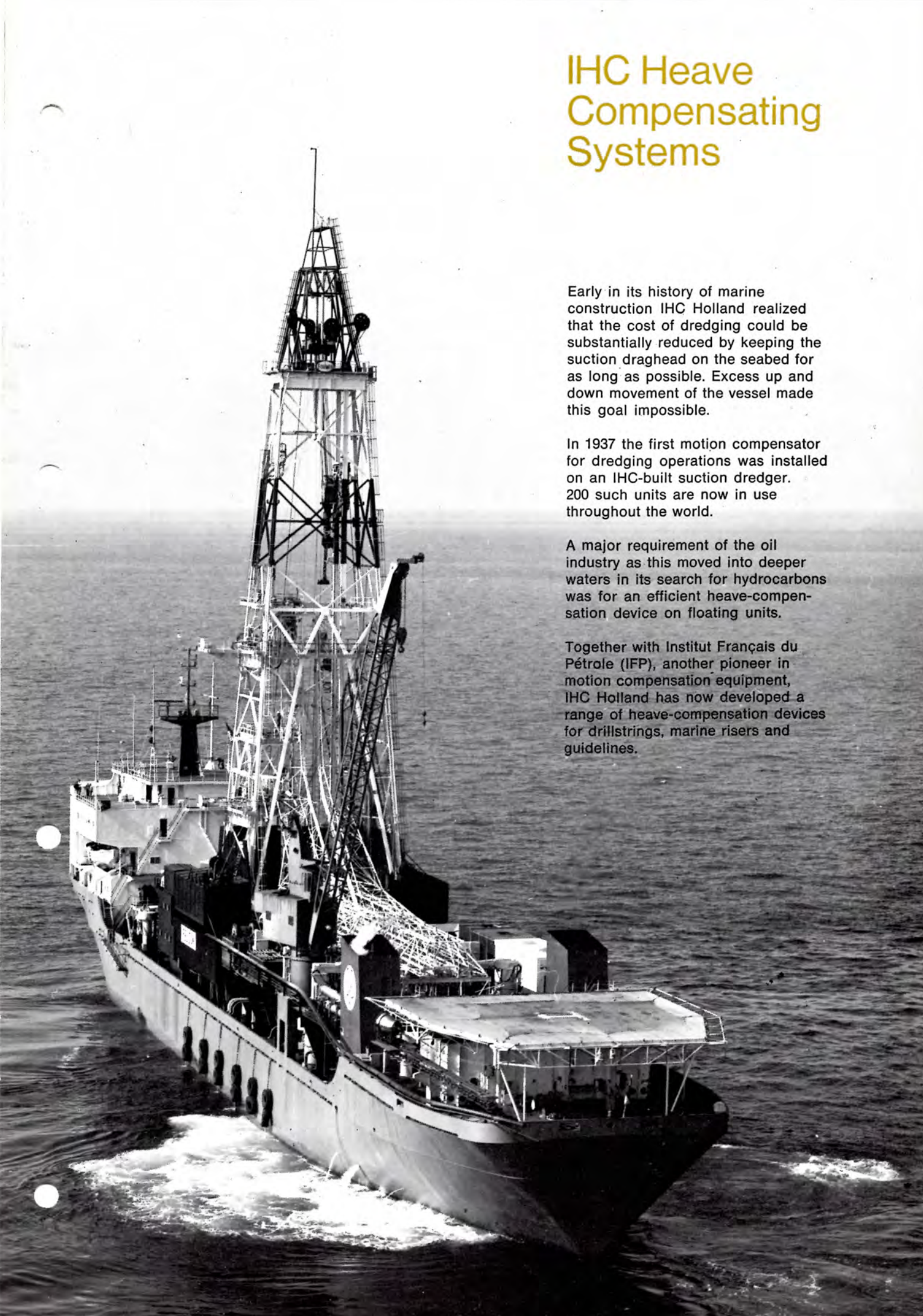
IHC offshore division

CONTENTS

IHC OFFSHORE DIVISION
PO BOX 11 - 5, MAASDIJK
SCHIEDAM - HOLLAND
TEL (010) 26 04 20
TELEX 23159

USA office:
J. W. BILLARD & ASSOCIATES INC.
AMERICANA BUILDING - SUITE 616
811, DALLAS STREET
HOUSTON - TEXAS 77002
TEL (713) 224-0706 - TELEX 762186

IHC Heave Compensating Systems



Early in its history of marine construction IHC Holland realized that the cost of dredging could be substantially reduced by keeping the suction draghead on the seabed for as long as possible. Excess up and down movement of the vessel made this goal impossible.

In 1937 the first motion compensator for dredging operations was installed on an IHC-built suction dredger. 200 such units are now in use throughout the world.

A major requirement of the oil industry as this moved into deeper waters in its search for hydrocarbons was for an efficient heave-compensation device on floating units.

Together with Institut Français du Pétrole (IFP), another pioneer in motion compensation equipment, IHC Holland has now developed a range of heave-compensation devices for drillstrings, marine risers and guidelines.

The IFP - IHC Unicode Heave Compensator

A small prototype of the present equipment was installed in 1964 on the French research vessel "Terebel". The unit was extensively tested in the Mediterranean and the Persian Gulf, and is still in service.
The IFP - IHC Compensator can be installed between crown block and derrick; it can also be incorporated into the design of the travelling block. In either configuration it will eliminate unwanted up and down movement of the drillstring, or other tools, supported by the travelling block of a floating drilling rig.
Such a system would allow:

- maintaining a nearly constant bit load,
- elimination of unwieldy bumper subs in the drillstring,
- elimination of ram and bag wear in BOP's since the drillstring is virtually motionless at all times.

The system is the only crown block drillstring compensator currently in use offshore.
A further feature of the system is its ability to maintain the preset tension on the drillstring to within very close tolerances and completely independent of any vertical movement; this could derive from the rig due to sea motion, or from the drillstring due to normal downward movement. This enables the driller to keep the load on the bit at the most favourable level without having to use expensive, maintenance-prone bumper subs.
Since the drillstring is held virtually motionless with respect to its position to the seabed (except for normal movement as drilling progresses), the blowout preventer rams can be closed around the pipe without any fear that the seals of the rams will be stripped. In addition then, to providing improved drilling efficiency, the IFP - IHC Compensator will substantially increase the safety factor of any offshore drilling operation.
The crown block and the travelling block types are available for the following capacities:

- max. load to be compensated 220 - 330 tons
- max. stroke 15 - 25 ft.

Some Significant Features

Better Downhole Control
Giving improved operating efficiency in drilling, coring, fishing, testing and packer-setting operations, and setting of mud lines.

Substantially Reduced Accumulator Volume
The Unicode converter utilizes an accumulator volume about 85 % less than on a convential system and yet still achieves a hook load variation of only 1.5 %.

Simple Control
The complete system is under full control of the driller at all times. Pressure regulation up or down is by pushbutton; monitoring is foolproof and there is a clear display of the compensator status.

Bumper Subs Out
Both the drillstring and bit will be completely protected without requiring bumper subs.

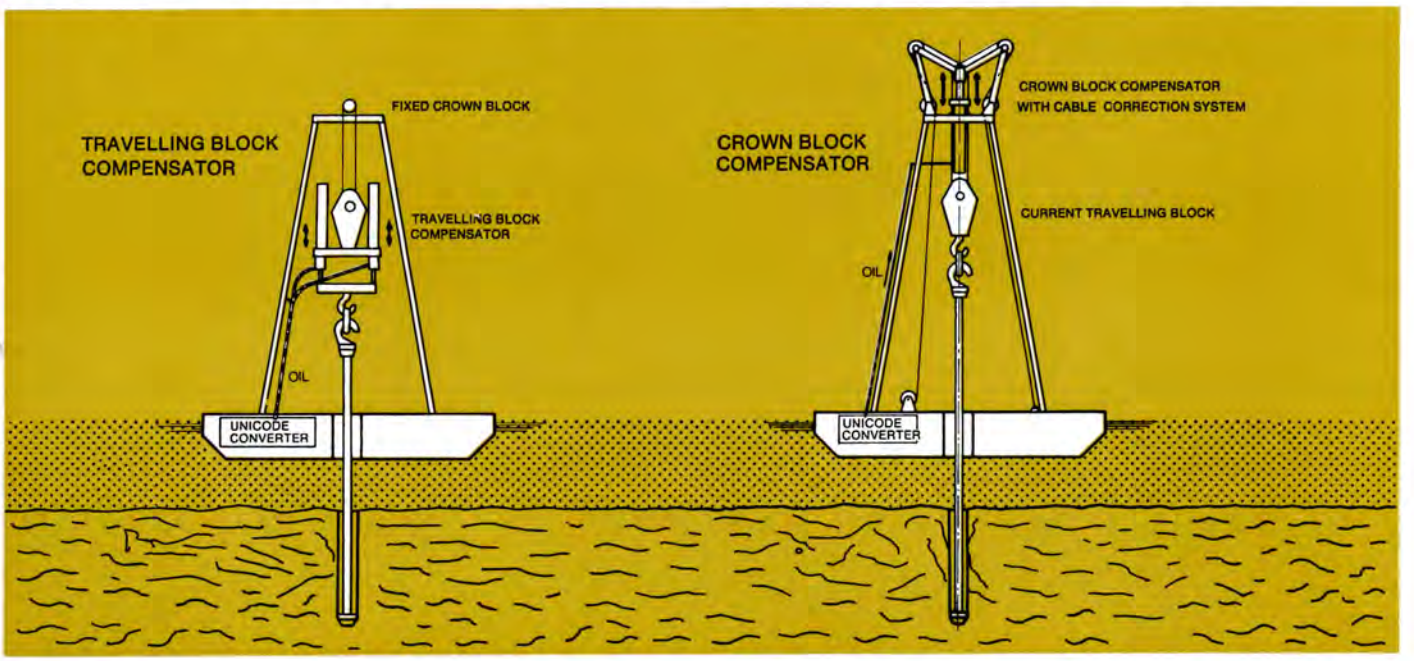
Longer Bit Life
Since there is continuous close control over the bit loading, downhole drilling conditions will be optimized resulting in fewer round trips.

Variable Bit Loading
To meet different formation requirements the driller can quickly, easily and accurately regulate the loading of the bit.

Bumpless Re-entry
BOP installation, casing setting, disconnection and re-entry operations can be made easier by installing an optional sensor line between the block and a deadweight on the seabed or marine riser. This will provide complete motion compensation whilst these tricky operations are performed.

Good Dynamic Response
The IFP - IHC Compensator prevents the buildup in the drillstring of resonant frequencies which, under certain conditions, could induce high dynamic stresses in drillpipes, blocks, swivel and drawworks.

"Spudding" Action Eliminated
Since the "spudding" and percussion effects of malfunctioning bumper subs will be completely eliminated, bits of all types will remain serviceable for longer periods.



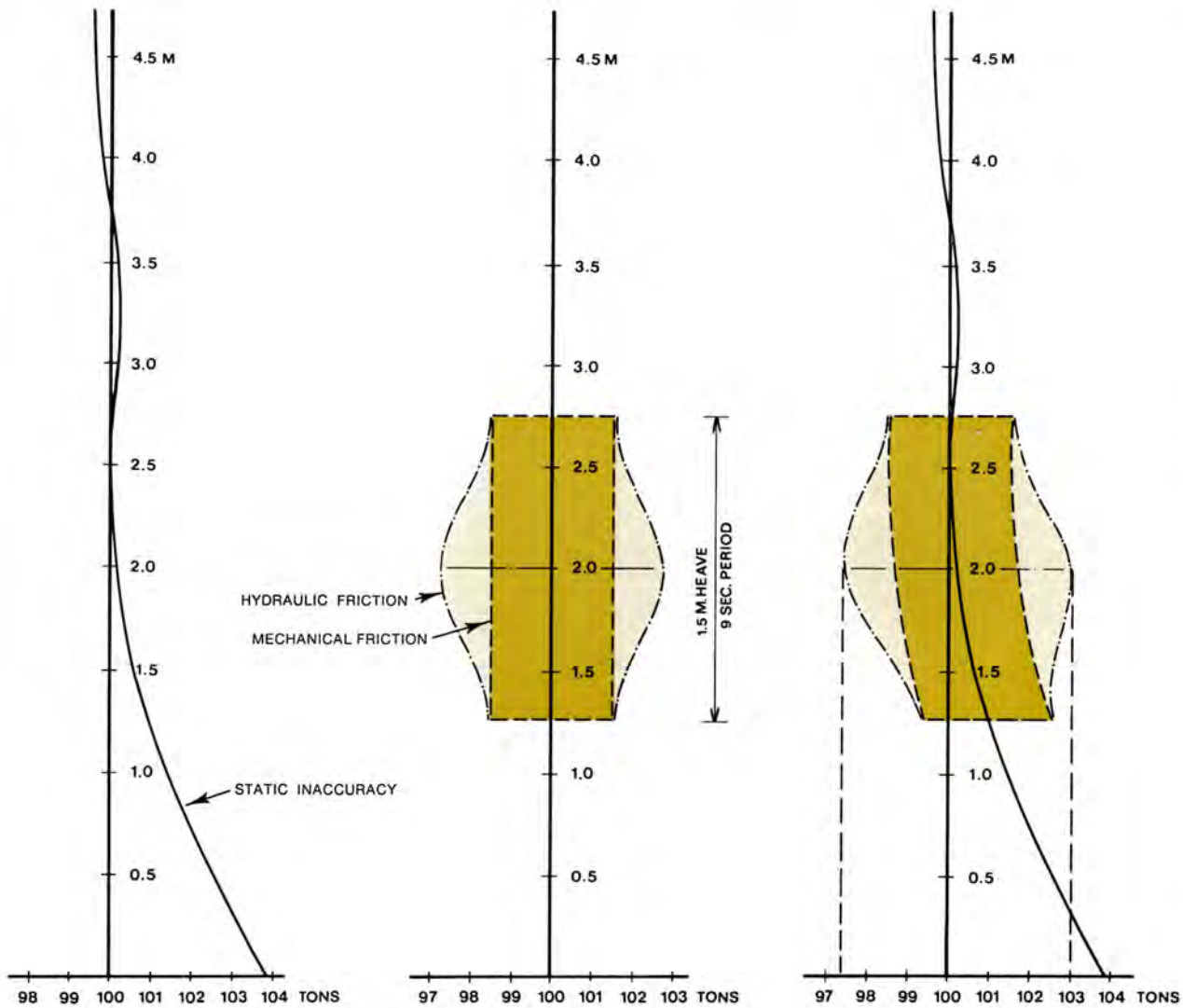
Improved Safety
Both bag and ram-type BOP's will be closed on motionless drillpipe so avoiding damage to closure seals by moving pipe.

Automized Drilling
Drilling operations can proceed automatically even at maximum heave since the compensator will maintain the required pre-set loading of the bit as the hole is drilled.

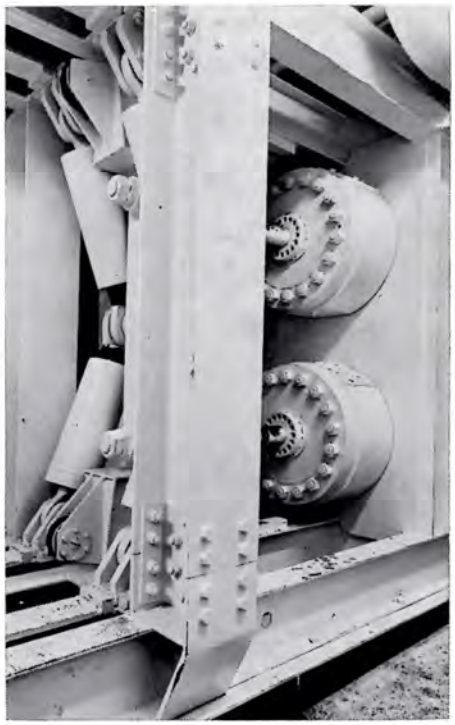
Performance
The most desirable feature of a drillstring compensator is an ability to maintain the overall hook load within very narrow limits irrespective of sea-induced motion.

Field testing has shown that the IFP - IHC Unicode Heave Compensator has achieved outstandingly good results.

The following typical hook-load deviation graphs are representative for the 15 ft/220-ton crown block type compensator installed on the dynamically-positioned drillship "Pélican".



Components of the IFP - IHC Unicode Heave Compensator



The major components of the system are:

a. Hydraulic Cylinders
attached to the crown or travelling block to convert hook load into hydraulic pressure.

b. Backup Guide Pulleys
(only on crown block compensator) to take up differences in length and eliminate unwanted ton mileage in the main hoist cable.

c. Hydraulic Valves
located in the hydraulic lines between cylinders and Unicode unit. For slowly braking and then hydraulically locking the system in any required position with respect to the derrick. Function also as safety valves in that they will close rapidly after loss of the hook load or rupture of the hydraulic pipes.

d. Unicode Converter
functions as a small-volume medium exchanger and provides a correct and almost constant hydraulic pressure over the full stroke to achieve controlled tension at the hook.

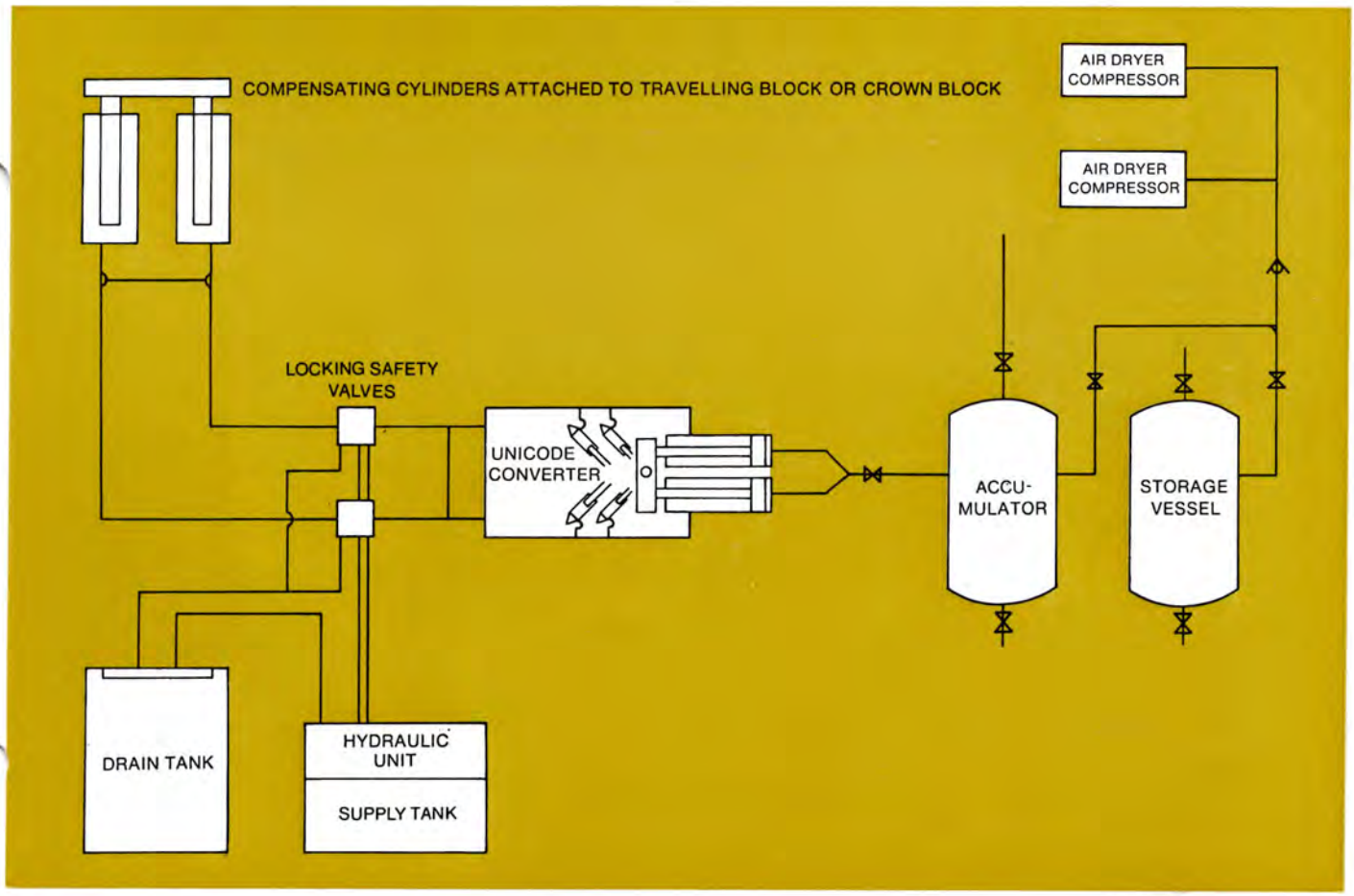
e. Compressed Air Reservoirs
operate in parts as accumulators fulfilling the spring function of the system. Also provide storage capacity for the system to increase its flexibility.

f. Air Compressor
to increase the regulating pressure in the gas accumulator to control the loading on the bit.

g. Fluid Supply System
automatically tops up the hydraulic system.

h. Monitoring and Control System
monitors and displays information taken from each manual and automatic function of the system.

Different types of hydraulic cylinders (item a) are used for the crown block and travelling block compensators.



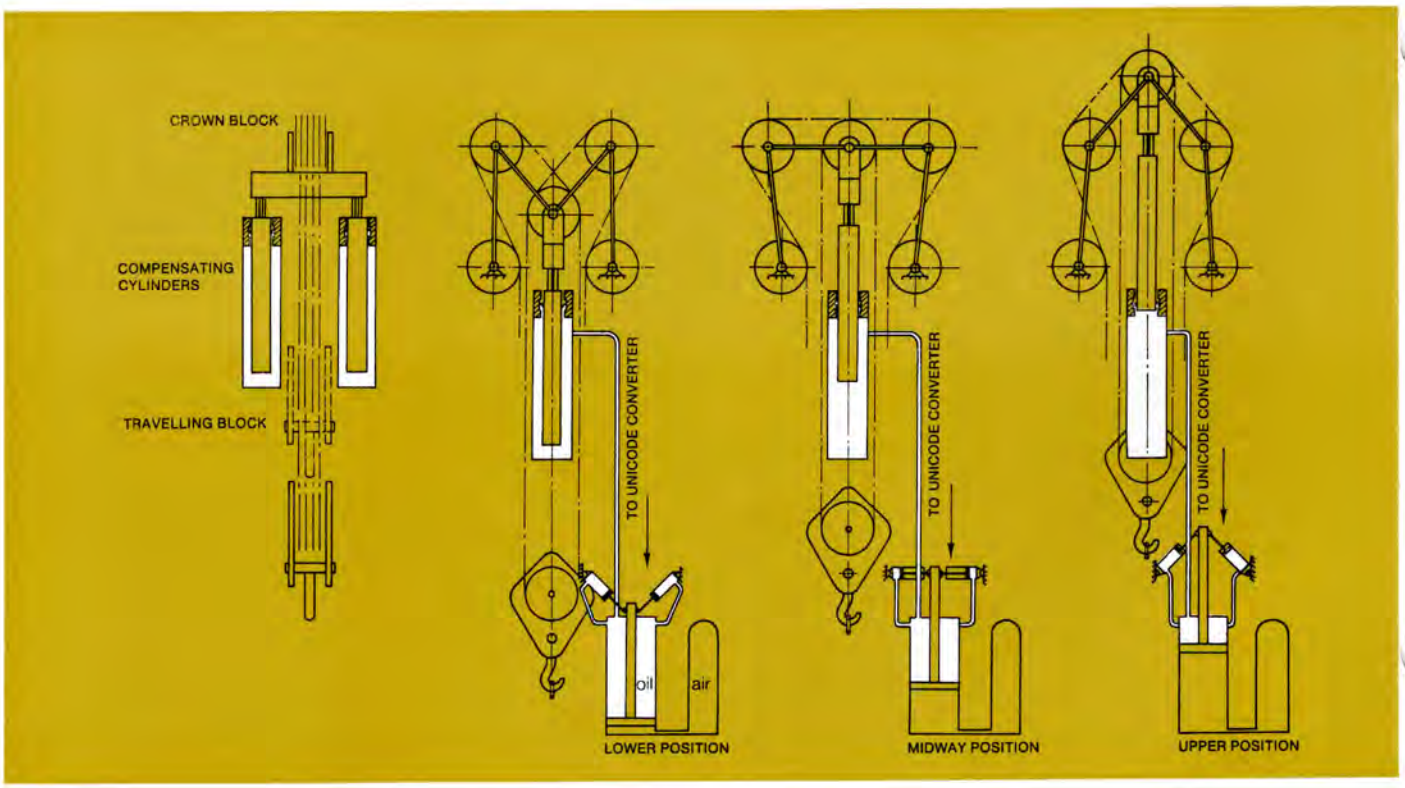
Crown Block Drillstring Compensator

The IFP - IHC Crown Block Compensator is installed between the crown block and the derrick; it comprises a pair of hydraulic cylinders whose function is to convert hook load into hydraulic pressure. The pistons of the cylinders are attached to the crown block via a fixed vertical frame.
A major advantage of the crown block Unicode compensator over the more convential travelling block system is that it dispenses completely with damage-prone hydraulic hoses inside the derrick structure. In addition to eliminating hose rupture due to rapid and constant changes in the travelling block position caused by normal drilling procedures, fixed hydraulic piping means that the inside of the derrick is completely free of obstructive hoses so facilitating pipe racking and handling operations. Fixed piping also means little or no maintenance.
A Unicode converter maintains the hydraulic pressure at an almost constant level. During operation of the system, the force exerted by the hydraulic cylinders will always equal the weight of the total drillstring minus the weight of the bit. Since the weight of the drillstring is known and is held constant during drilling until another joint is added, the operator can accurately control the loading on the bit by regulating pressure in the gas accumulator.

Hydraulic fluid is used on the cylinder side of the system so that the hook can be locked in a motionless position with respect to the derrick and additional pipe joints can be added

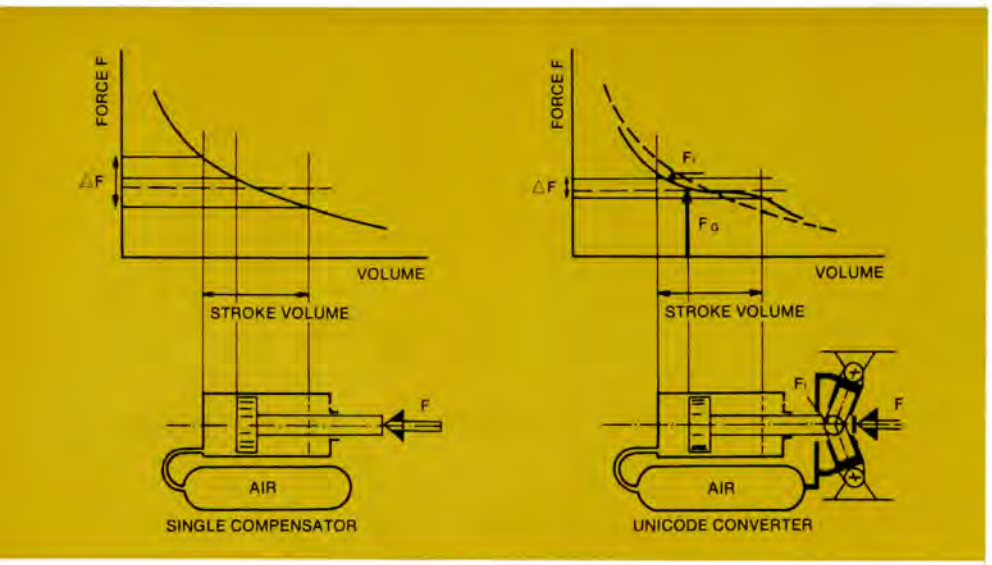
Since the crown block will now remain virtually motionless with respect to the seabed, but not with respect to the derrick, some form of length compensation will be required for the main hoist cable. The system chosen by IHC comprises a series of guide pulleys on pivoted arms.

Both the fast and dead lines of the crown block are reeved over the pulleys so that the clearance between hoist and block will be held virtually constant.
This arrangement excludes the possibility of extra ton mileage on the main hoist cable. The total compensation system has been designed to assimilate the slight variations in vertical force caused by the guide-pulley arrangement.
The weight of that part of the system installed in the top of the derrick has been kept to a minimum; this means that only minimum strengthening will be required on a standard derrick.
The two cylinders are pipe-connected to the Unicode converter which is mounted along with its accompanying accumulator and compressor on the vessel's deck.
Safety valves incorporated into the the design will automatically shutoff the flow of hydraulic fluid to the cylinders should the flow rate increase above the safe working level. This might be caused by line breakage or a sudden removal of the hook load.



How the Unicode Converter functions

The major function of the Unicode Converter is to supply or receive, on demand, hydraulic fluid under a wide range of volumes but at a nearly constant pressure. It also functions as a medium exchanger.
The IFP - IHC designed Unicode converter consists in the main of a pair of hydraulic cylinders whose pistons are connected to four pivot-mounted backup cylinders. The system is mounted in a rigid supporting frame.
The active fluid volume flows into the two main cylinders which have fluid on one side of their pistons and pressurized air on the other. The gas side is connected directly to the accumulator of the system. Fluid flowing into the main cylinders will force the pistons against the gas. This decreases the gas volume but increases the pressure exerted by the gas against the fluid. Outgoing fluid from the two main cylinders reverses the action and reduces the effective pressure.



Pivot-mounted backup cylinders connected to the top ends of the main cylinder pistons will substantially reduce oil pressure variations. With the main cylinder pistons in the midway position, the four backup cylinders will be located at right angles to the main pistons and the force exerted will be zero. As the main pistons move to their maximum out or in positions, the four backup cylinders will be exerting maximum force but of a different sign on the main-cylinder pistons. Each backup cylinder is connected directly to the main cylinders.

The Unicode converter is connected to the crown or travelling block hydraulic cylinders by fixed pipes or flexible hoses respectively. Fluid at almost constant pressure is transmitted through the connecting pipes or hoses.

System Control
The driller sets the drillstring compensator at the required operating pressure. This will depend on the weight desired on the bit, the buoyant weight of the drillpipe, and the weight of the drillcollars. A compressor working through backup storage vessels is provided to allow pressure on the gas side of the Unicode converter to be increased instantaneously as additional pipe joints are added.
As drilling proceeds the hoist will be unwound sufficiently, as required, to keep the main hydraulic cylinders swinging around their midway positions.

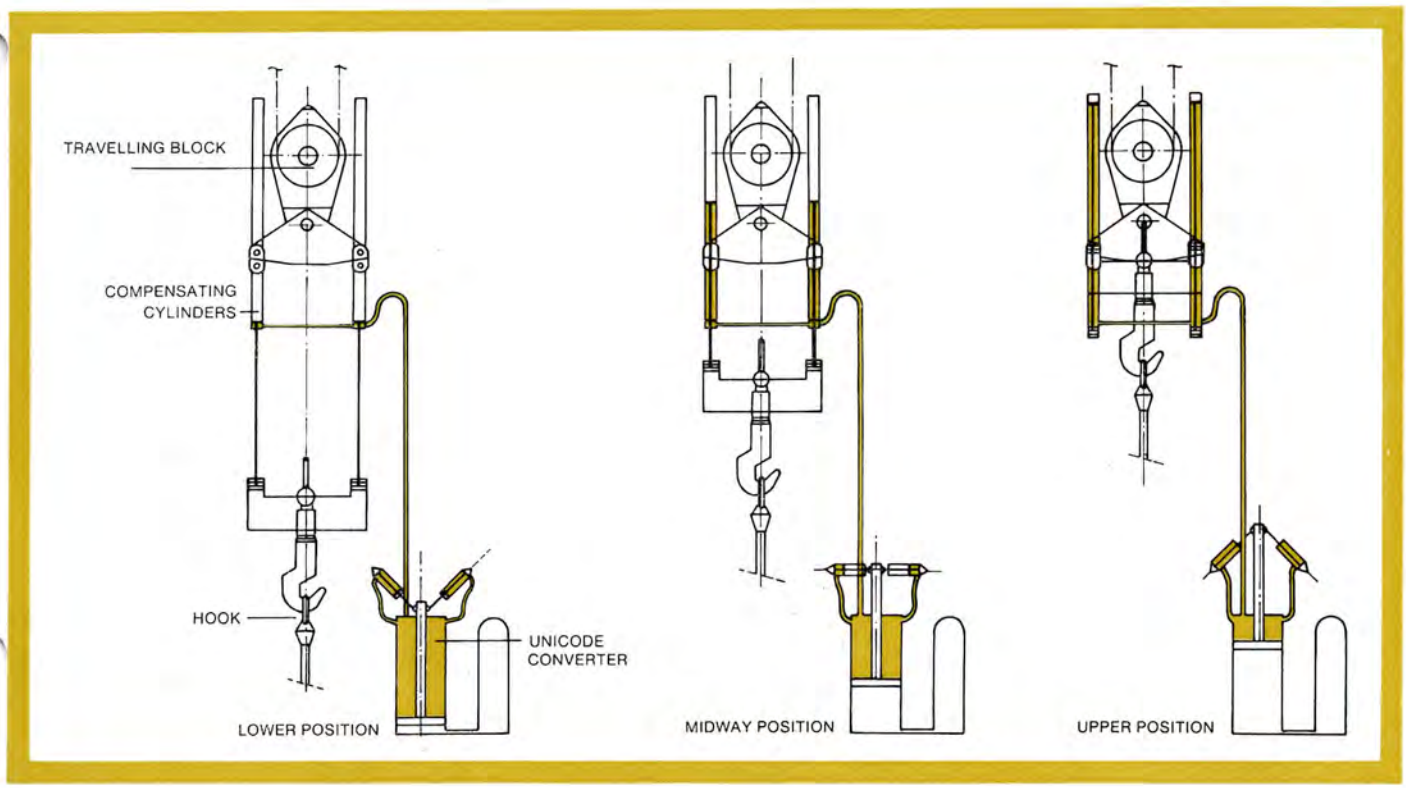
Travelling Block Drillstring Compensator

IHC also makes available a Unicode Travelling Block Heave Compensator. An advantage claimed for this configuration is that it can be readily applied to existing drilling equipment.

In this arrangement, two hydraulic cylinders are mounted between the upper and lower frames of the travelling block, which will be attached to a normal standard hook.

The two cylinders convert hook load to hydraulic pressure. A mechanical lock is provided between the hook and the travelling block.

The two cylinders are flexible-hose connected to the Unicode converter which is mounted with the accumulator and compressor on the vessel's deck. The compensator functions in the same manner as the unit installed on the crown block.




PELICAN

IHC HOLLAND
PO Box 6141 Rotterdam

IHC HOLLAND (AUSTRALIA) PTY LTD
37/49 Pitt Street
Sydney 2000 NSW Australia

IHC HOLLAND (SOUTH EAST ASIA)
Regional Sales Office
84 Jalan Ampang
Kuala Lumpur Malaysia

OFFSHORE DIVISION
PO BOX 11 SCHIEDAM
Drilling platforms, drillships, offshore structures, single buoy mooring systems, pipelaying barges, self-elevating platforms for civil engineering purposes. Floating cranes. Structural steelwork. Special-purpose vessels. Standard winches. Anchoring and installation of mooring buoys. Offshore engineering.

DREDGER DIVISION
PO BOX 1 KINDERDIJK
Standard and custom-built dredgers, dredger components, measuring and control equipment, dredging pipes. Diesel engines, Propeller shaft seals. Aluminium and polyester products. Ship-repairs. Engineering.

MINING & TRANSPORT DIVISION
PO BOX 3084 AMSTERDAM
Equipment for the recovery, concentration and separation of ores. Transshipment installations for bulk cargoes such as grain and copra. Engineering for alluvial mining, ore treatment and bulk goods handling. Equipment for the mechanizing and automating of industrial processes.

IHC OFFSHORE DIVISION-PO BOX 11-SCHIEDAM-HOLLAND-TEL.010-26 04 20-TELEX 23159