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JANUS IV

Sa Comex

► **To cite this version:**

| Sa Comex. JANUS IV. COMEX. 1977. hal-04465038

HAL Id: hal-04465038

<https://hal.univ-brest.fr/hal-04465038v1>

Submitted on 19 Feb 2024

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COMEX (Compagnie Maritime d'Expertises), established in 1962, has positioned itself in the offshore activities sector, where it held a leading international position, becoming the world's foremost company in engineering, technology, and human or robotic underwater interventions. Comex designed a Hyperbaric Testing Center in 1969 and developed its own research programs on various breathing mixtures used in deep-sea diving (helium and later hydrogen). These research efforts led to spectacular advancements in this field, including several world records, both in real conditions and simulations. Comex still holds the world record at -701 meters, achieved in its chambers during Operation HYDRA 10.

The ORPHY laboratory focuses on major physiological functions, their regulation, interactions, and their contribution to the development and prevention of certain pathologies. The primary mechanisms studied involve metabolic aspects (oxygen transport and utilization, energetics, etc.) and electrophysiological aspects (contractility and excitability), mainly related to respiratory, vascular, and/or muscular functions. These mechanisms are studied under various physiological and physiopathological conditions, ranging from the cellular and subcellular levels to the entire organism. In Europe, the ORPHY laboratory is one of the leaders in hyperbaric physiology and diving research.

Being a major player in innovation and expertise in the field of pressure, COMEX maintains a scientific archive from its experimental diving campaigns. The value of this archive is both scientific and historical, as it documents a remarkable chapter in the history of marine exploration and contains results obtained during dives that are very unlikely to be replicated in the future.

C N E X O

C O M E X

MARINE NATIONALE (GISMER - DRME)

J A N U S . . . I V

DIVER LOCKOUT OPERATION

AT 1510 FEET (460 METERS)

OCTOBER 15TH TO 28TH 1977

JANUS IV

C O N T E N T S



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OPERATION "JANUS IV"

The CENTRE NATIONAL POUR L'EXPLOITATION DES OCEANS (C.N.E.X.O.), COMEX and the FRENCH NAVY (GISMER and DRME) are about to carry out, at 1510 feet (460 m) below the surface of the sea, a diver lockout operation of which COMEX is in charge, called Operation "JANUS".

It will take place off Cap Bénat in the Mediterranean between October 15th and 28th from the dynamically positioned drill ship "PETREL", which has generously been put at the disposition of the Project by the ELF-AQUITAINE Group.

The purpose of this operation is to prove :

- . that it is possible for human beings to descend in the sea to a depth of 1510 feet, and
- . that at this depth it is possible for them to perform work such as is regularly done now in the 700' range and exceptionally the 1000' range (200 - 300 meters).

"JANUS IV" is the logical sequel to the series of hyperbaric experiments undertaken by COMEX since 1965, and particularly

to " JANUS I ", " JANUS II " and " JANUS III " :

" JANUS I " (October 1968)

This was the first time an underwater operation was performed by divers living in saturation chambers aboard a surface vessel. At a depth of 150 m (500') on the side of the Fosse de Cassidaigne off Cassis, in the Mediterranean, two 2-man teams worked successively on an offshore oil wellhead. The saturation for each team lasted six days.

ELF, COMEX and the FRENCH NAVY jointly financed and organized this world first.

" JANUS II " (October 1970)

" JANUS II ", using the same methods as " JANUS I ", represented a major step forward in human access to the ocean depths, thus in the possibility of working under the sea. The base site in the Bay of Ajaccio (CORSICA) was 253 m deep (830'). Three COMEX divers went down twice a day to this real subsea work site and successfully cut a pipeline and welded the connection.

In one week 13 dives were made, for a total of over 26 hours of bottom time for the bell and 35 man-hours of underwater work.

This was undeniable proof that specially trained and equipped divers could work effectively at such depths, later extended to 326 m by a COMEX team during a wellhead recovery operation off Labrador in 1975.

Operation " JANUS II " was jointly sponsored by C.N.E.X.O., ELF and COMEX.

" JANUS III " (April 1975)

Simulated working dives in water pressurized to the equivalent of 390 - 450 m depth (1280 - 1475 ft.) in the new COMEX hyperbaric facilities (including a hyperbaric pool) at MARSEILLES. This experiment was conducted for the purpose of :

- verifying certain physiological and ergonomic data.
- perfecting the individual diving equipment required for actual sea dives at such depths.

" JANUS IV " (October 1977)

The entire operation includes two preparatory phases plus this third phase, which is the actual sea dive :

PHASE I - DIVER SELECTION -

The purpose of the first phase, in October 1976, was to detect any physiological and clinical inaptitudes, or to discern the varying degrees of inaptitude, in a number of candidates. In this phase a group of twenty prescreened volunteers underwent a series of seven tests at depths in the 180-210 meter range (590-690').

In addition to the usual obligatory medical control, these tests were designed to evaluate :

- . sensitivity to compression, by clinical observation of the

- following symptoms : trembling, dizziness, nausea, dysmetria, and high pressure articular syndrome .
- . sensitivity to high pressure, by means of the electroencephalograph (E.E.G.), which objectifies the occurrence of the slow waves characteristic of H.P.N.S. (High Pressure Nervous Syndrome).
 - . Vigilance, by means of a series of psychosensory tests of for instance, visual choice reaction time, and intellectual tests such as arranging number sequences and perceiving sign barriers. These were accompanied by E.E.G. and pulse rate measurements.
 - . manual dexterity, by means of a test on the ability to arrange and insert pegs in holes.
 - . function study :
 - measurement of cardio-respiratory adjustment to physical work, of ventilatory mechanics, vital capacities, electrical impedance and air bubble detection.
 - . physiological reaction as measured by urinalysis.
 - . self-evaluation capacity, measured by questionnaires filled in by the divers themselves concerning their own situation and condition.

This set of tests made it possible to compare the performances of the diver candidates and, more importantly, to evaluate their fitness for very deep diving and for the type of work apt to be required at such depths.

PHASE II - THE DRESS REHEARSAL -

This phase was in effect a dress rehearsal for Phase III, i.e., an operation simulating as closely as possible the actual conditions and the 460 m pressure depth to be encountered at sea. It took place in the COMEX hyperbaric modular complex E.M.S. 600 in December 1976 and had as object :

- to accustom physiologically and psychologically the personnel selected in Phase I to such conditions.
- to test their adaptability to these conditions.
- to test the individual diving equipment in these conditions and make whatever modifications might prove necessary.

The eight FRENCH NAVY and COMEX divers who had been selected lived for eight consecutive days at a pressure corresponding to a depth of 1310', or 400 m.

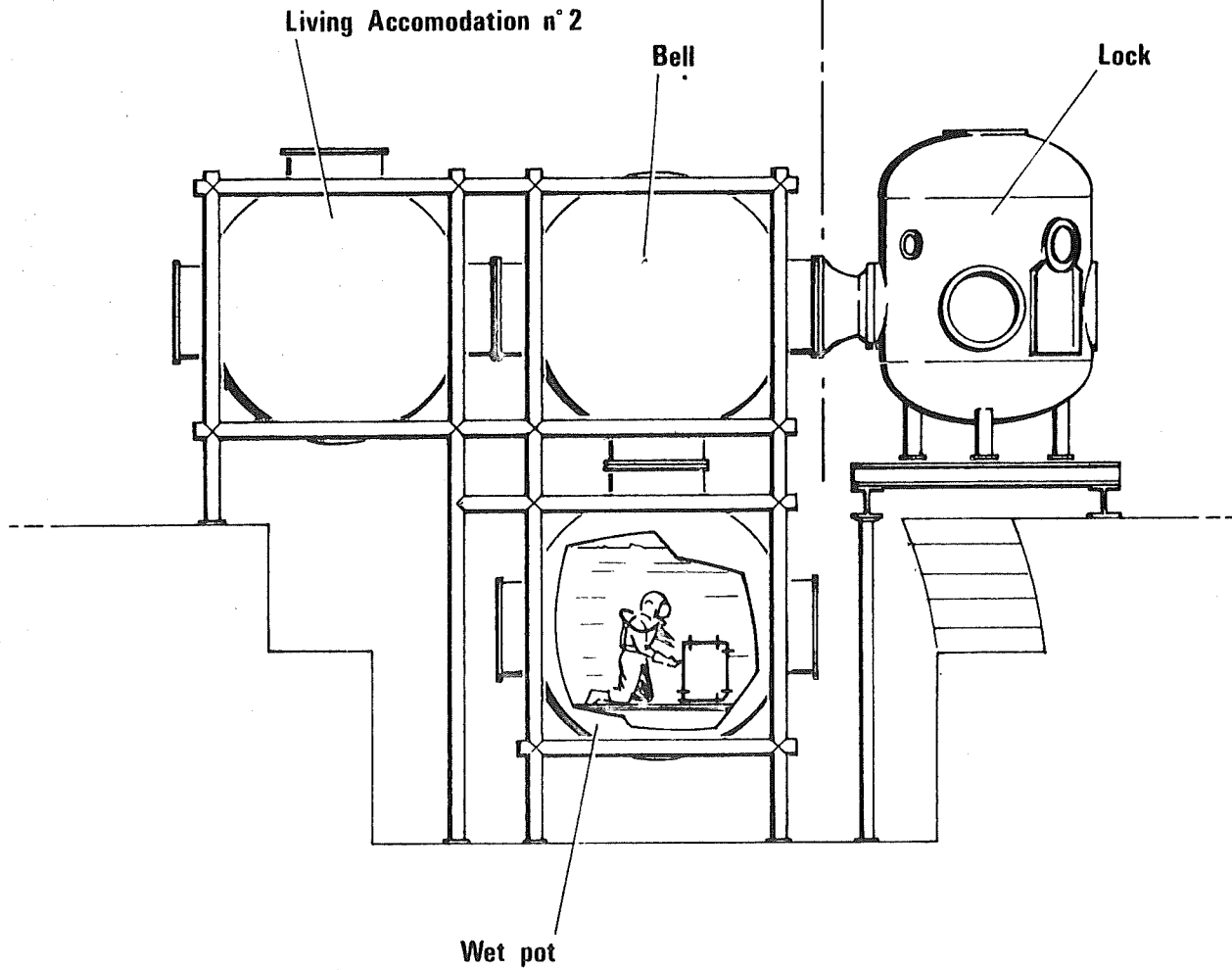
From this living depth incursion dives were made in a special pressurized pool to depths of 430, 445, 460 and 480 meters (1410, 1460, 1510 and 1575', respectively).

During the first two days six dives representing a total of 9h.15 of work time demonstrated the ability to work effectively

CROSS-SECTIONAL. View A-B

EMS 600 Hyperbaric System

Supplementary System

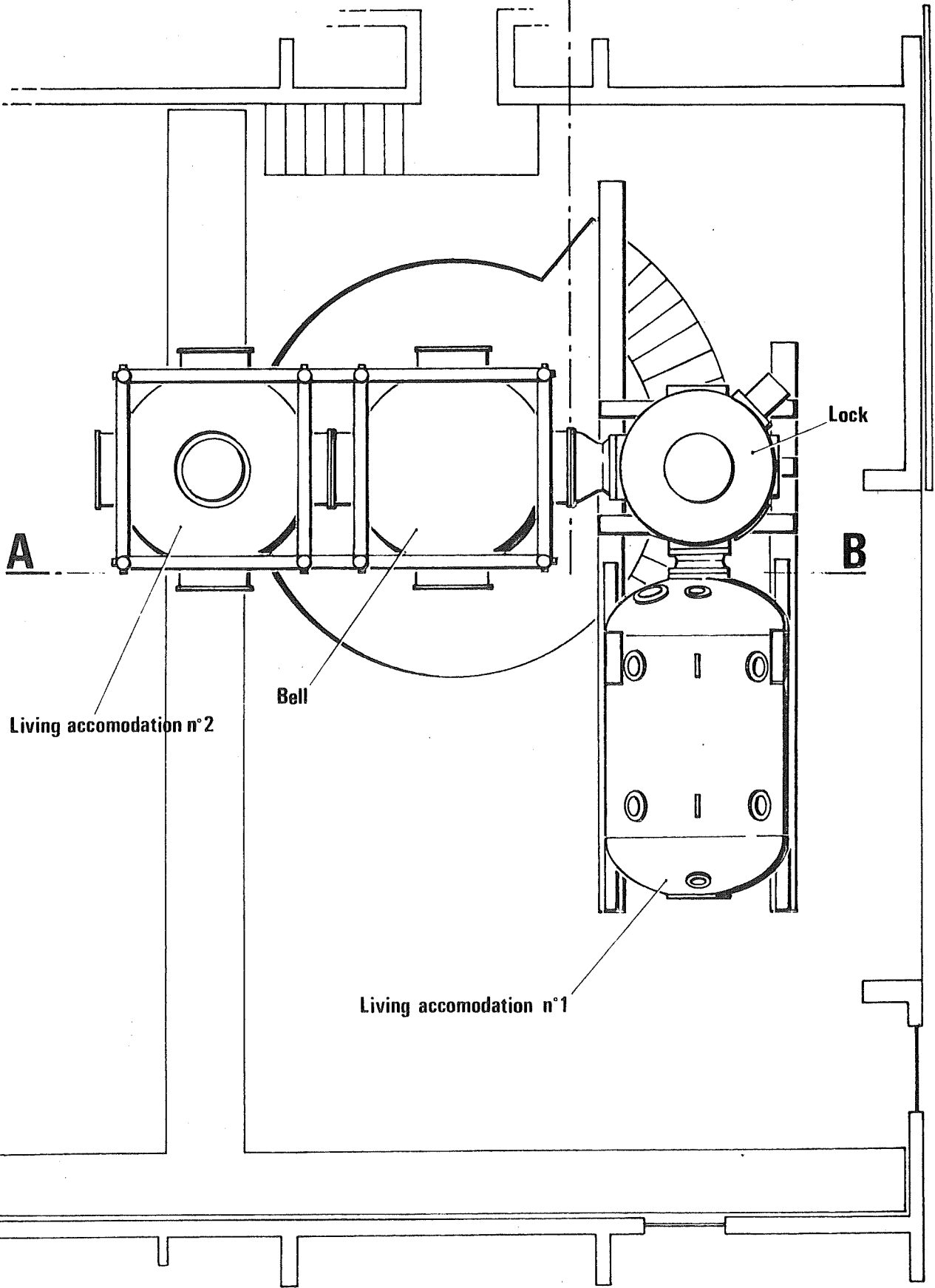


diving system used for phase 2

PLAN VIEW.

EMS 600 Hyperbaric System

Supplementary System



in - 430 m of water at 4° C.

Four additional work dives were made to - 445 m for a total of nearly 5 hours.

In order to simulate the depth goal of the sea phase of " JANUS IV " there were then twelve work dives over a three day period, for an effective work total of 12h15, at - 460 m.

Lastly, a final dive to an unprecedented - 480 meters (1575') was made for 10 minutes in 6° C. water.

Physiologically speaking the work done confirmed that these depths had no effect on :

- . manual dexterity
- . capacity for reflection
- . physical strength

This was shown by means of the work task assigned the divers : assembling and tightening up a " puzzle " of 20 elements of 2" pipe.

Trying conditions of diving time and frequency made it possible to reasonably ascertain the limits of human endurance.

Dives in water whose temperature varied from 2° to 7° C., also confirmed that the individual diving equipment such as hot water diving suits and breathing gas heaters were operational at depths down to 480 meters.

Phase II of the " JANUS IV " Project thus resulted in the selection of six physically, psychologically and physiologically fit divers, and in verification of the validity of the equipment for the final sea phase of the Project, Phase III.

PHASE III - OPERATION DEEP SEA DIVE

This phase, which is the ultimate object of " JANUS IV ", is to consist of a series of operational dives in the sea at a depth of 460 meters, or 1510 feet. Its purpose is to prove that divers can do the work required for offshore oil production at this depth.

The COMEX deep diving system has been installed on the dynamically positioned ship " PETREL ", kindly lent as logistic support by the ELF AQUITAINE Group for the operation.

The operation is to take place from October 15 to 28th between the Cap de Benat and the Ile du Levant in the Mediterranean.

Six divers, two from the FRENCH NAVY and four from COMEX, will be saturated to a living depth of - 430 m in two teams of three which will dive alternately to the 460 m working depth.

DESCRIPTION OF JOB TO BE DONE AT THE BOTTOM

The task of the work dives, which are to take place over a three-day period, is to make an 8" pipeline tie-in with a " COMECTOR " mechanical connector. In order to perform this connection the following preparatory steps must be successfully carried out, in this order :

- measuring the length of pipe to be cut.
- cutting the pipe to the determined length.
- installing the " COMECTOR " on one of the pipes.
- positioning the pipes and " COMECTOR ".
- fitting the joints.
- tightening of Comector bolts to the required torque
- hydraulic test of connection to check tightness of seal.

C O M E C T O R

NEW CONNECTOR FOR UNDERWATER PIPELINES.

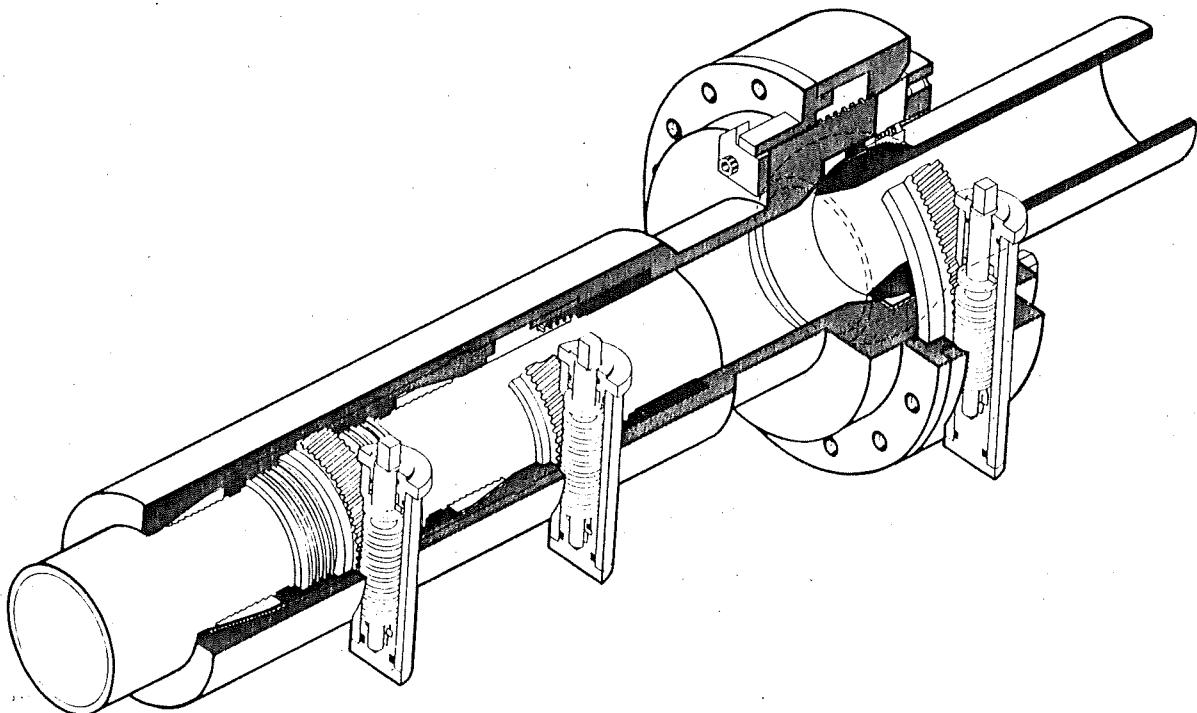
Deepwater pipeline connection is one of the most difficult problems encountered in offshore oil operations.

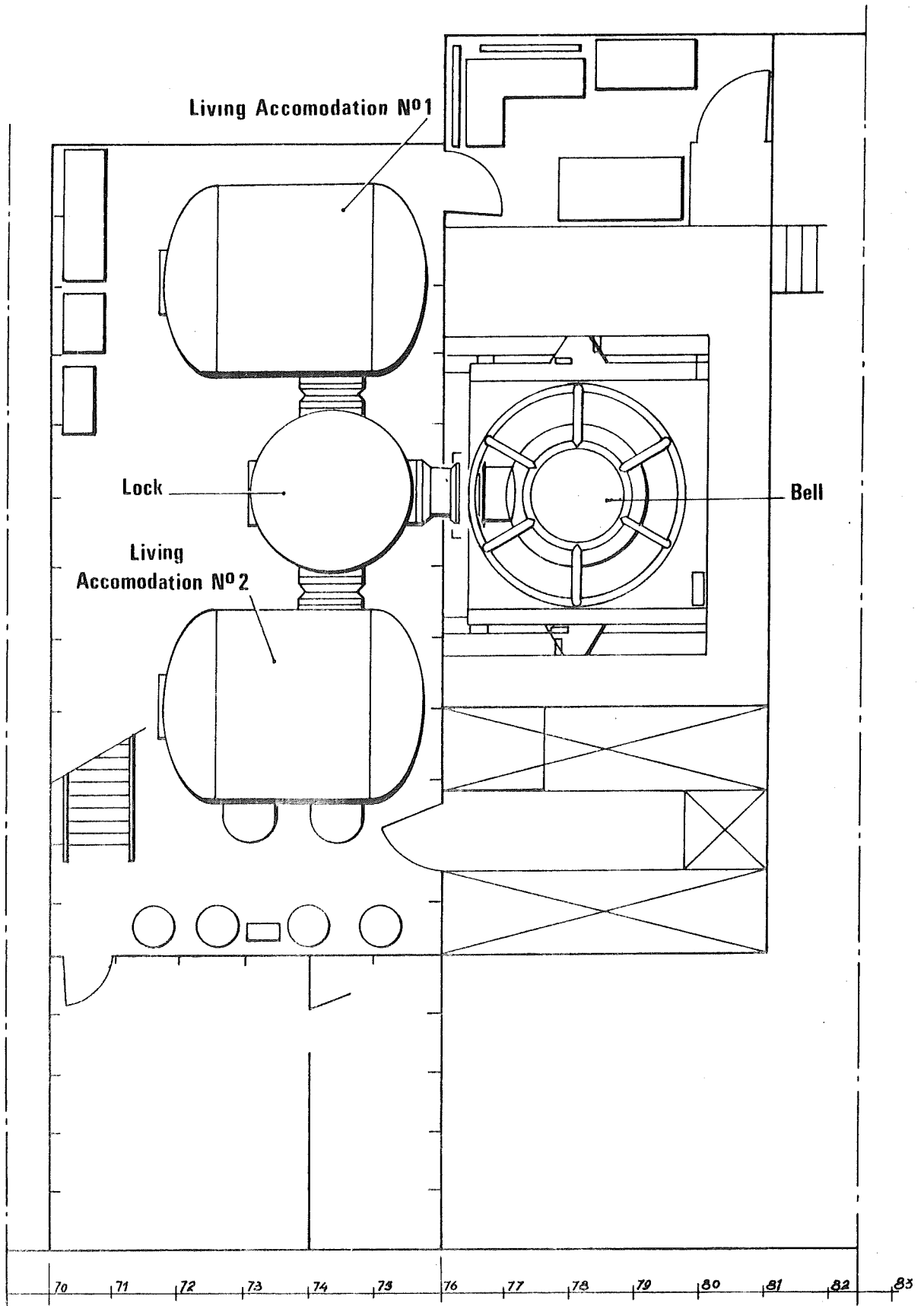
Now, with the development of the Comex Comector, a ready solution has been found.

From years of experience gained in connecting underwater flowlines throughout the world, Comex engineers drew up the exacting specification from which the Comex Research Division successfully developed the Comector.

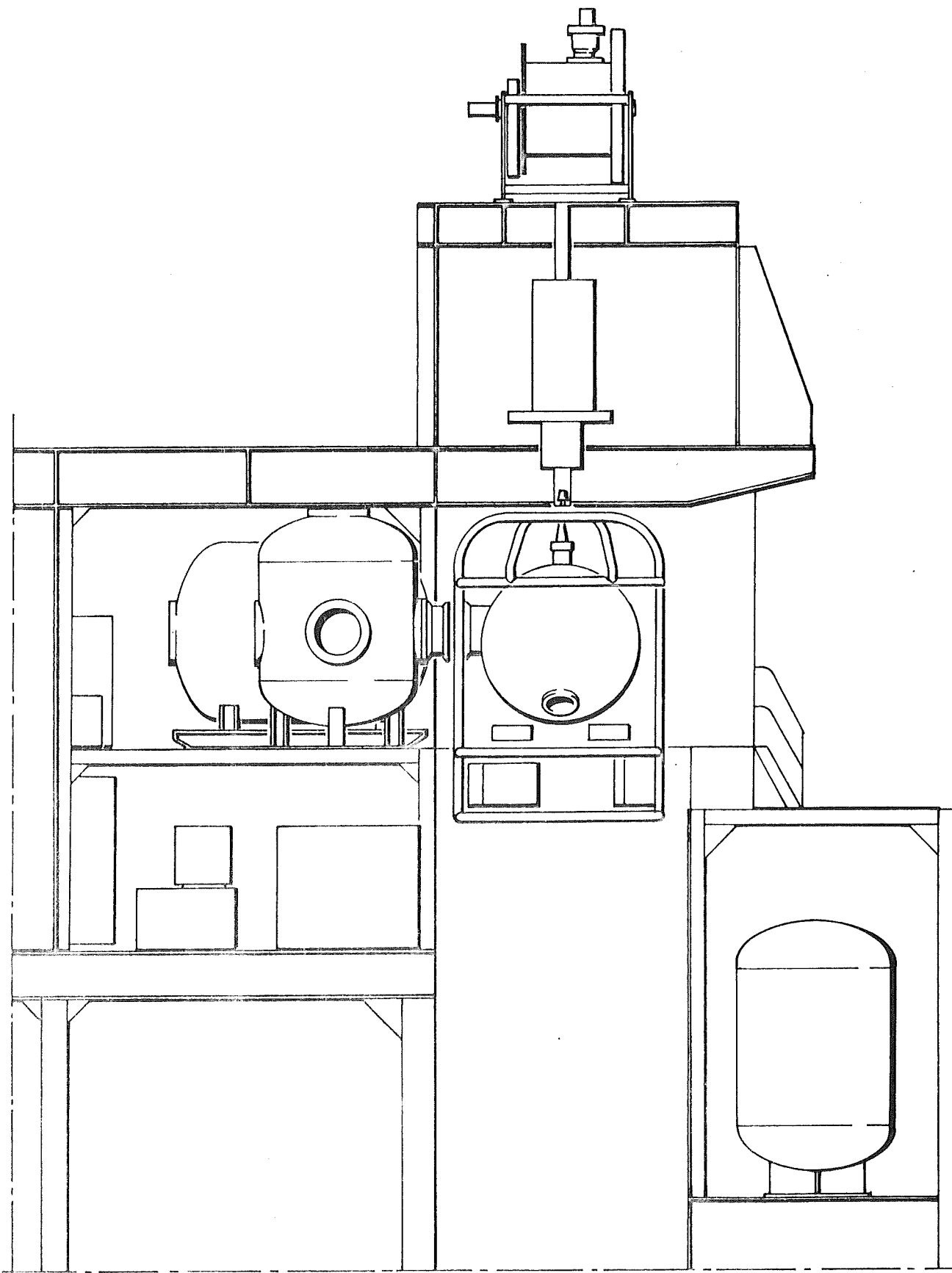
The Comector has many advantages over conventional systems for coupling pipelines. It achieves a tight seal entirely by mechanical compression; there are no hydraulically operated devices and no recourse to epoxy injection. Once set it remains perfectly rigid, even if pressure in the pipeline is completely released. It can be re-set easily or, if required, completely uncoupled without difficulty. The design also provides ample adjustment to facilitate the connection of misaligned pipes.

Applications for which the Comector is primarily intended include: riser repair and installation; mid-line connection and repair; mid-line T installation; subsea flexible hose connection to SPM buoys; and tanker loading hose connections.

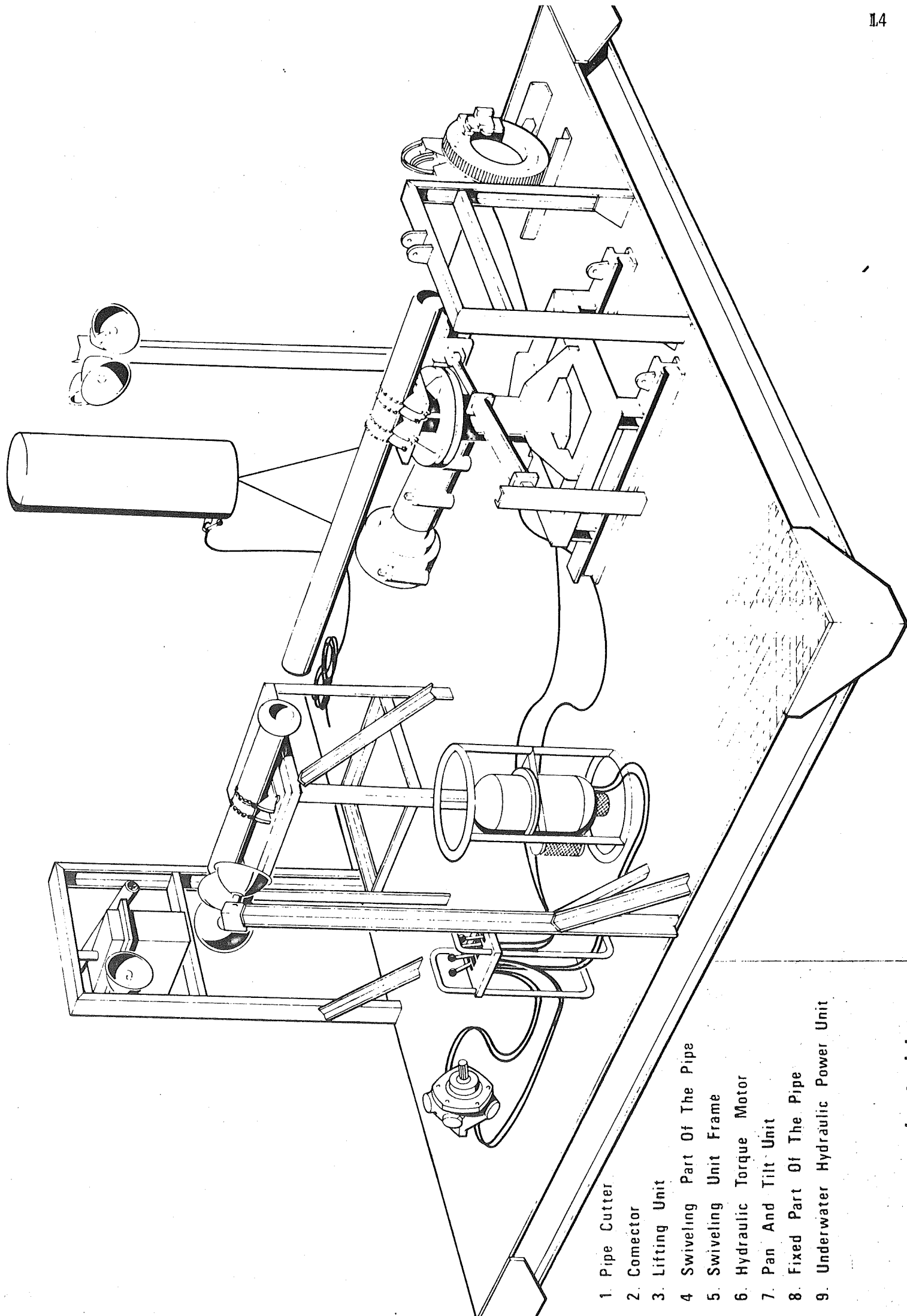




diving system aboard "PETREL"



diving system aboard "PETREL"



- 1. Pipe Cutter
- 2. Connector
- 3. Lifting Unit
- 4. Swiveling Part Of The Pipe
- 5. Swiveling Unit Frame
- 6. Hydraulic Torque Motor
- 7. Pan And Tilt Unit
- 8. Fixed Part Of The Pipe
- 9. Underwater Hydraulic Power Unit

work table

OPERATION DEEP SEA DIVE TIMETABLE

Saturday October 15 9h00 : Saturation starts

Sunday October 16 about 3h00 : " PETREL " sets sail from
 MARSEILLES.

Sunday October 16 : " PETREL " takes up position
 on " JANUS IV " site.
 Divers' work table put in position
 on the sea bottom.
 Living depth of 430 m reached.

Monday October 17 about 6h00 : First dive to 460 m


 October 17, 18, 19 : Diving program

Friday October 28 : End of saturation at MARSEILLES.

ESTIMATED SCHEDULE FOR OPERATION JANUS IV - PHASE III

DATE	HYPERBARIC PROGRAM	NORMOBARIC PROGRAM	ESTIMATED TIME
Day (D-1)	Compression of divers to 400 meters	PETREL in port	24 hours
Day (D)	Compression stop at 400 meters	PETREL en route to site of JANUS IV	6 hours
Day (D)	Compression of divers to 430 meters	PETREL on site	0H30
Day (D)	Compression stop at 430 meters	- Positioning of base plate - Positioning of work table - Observation dive	17H30
Day (D+1)			
06H00	Team A first dive	Diving bell launched))) 6H37
06H30	Compression to 460 m in diving bell		
07H00	Dive begins		
11H30	End of dive, start of decompression to 430 m	Ascent of diving bell)))
12H37	End of decompression Transfer to DCC	Bell mated)))
13H30	Team B first dive	Bell launched)))
14H00	Start of decompression in bell to 460 m))) 6H37
14H30	Dive begins)))
19H00	End of dive, start of decompression to 430 m	Ascent of bell)))
20H07	End of decompression Transfer to DCC	Bell mated)))

ESTIMATED SCHEDULE "JANUS IV"

DATE	HYPERBARIC PROGRAM	NORMORARIC PROGRAM	ESTIMATED TIME
Day (D+2) 06H00 13H30	Team A second dive Team B second dive		
Day (D+3) 06H00 13H30	Team A third dive Team B third dive		
Day (D+3) 21H00	Stop 430 m	Preparation to raise work table))) 18 hours
Day (D+4) 15H00	End of 430 m to stop Start of decompression	- Raise work table - Raise base plate - PETREL en route to test site, SNEA (P))))
Day (D+5) Day (D+6) Day (D+7) Day (D+8) Day (D+9) Day (D+10) Day (D+11)))) Decompression)))))) ))) 7 days 17 hours 8 minutes
Day (D+12) 08H08))) END OF SATURATION))))))

C O N C L U S I O N

On June 6th, 1975, aboard the dynamically positioned drill ship " HAVDRILL " off the coast of Labrador in - 2° C. water a team of COMEX divers performed a subsea operation at the unprecedented depth of 326 meters, or 1070 feet.

The job, which consisted of recovering a wellhead for the offshore oil industry, proved that underwater work could be done by divers at this record depth.

The depths to which human beings can accede are directly linked to the solution of a certain number of problems of a physiological and technological nature. Preliminary Phases I and II of Operation " JANUS IV " have proven that these problems have been successfully solved for the depths in question.

Phase III, Operation Deep Sea Dive, will demonstrate that divers can in actual fact perform the underwater work necessary to offshore oil production at depths all the way down to 460 meters : 1510 feet .