E.L. 1895, 1896 & 1937 - ANNUAL REPORT

- INCORPORATING AN APPRAISAL OF OFFSHORE POTENTIAL FOR ALLUVIAL TIN IN DARWIN AND BYNOE HARBOURS.

prepared by

G.S. EUPENE, B.Sc (Hons Qld.),
M.AUS.I.M.M., M.M.I.C.A.
Consulting Geologist

for

the holders,
DIAGRAM PTY. LTD.

1:250 000 Sheet Area
: Darwin

1:100 000 Sheet Area
: Bynoe

March, 1982

Darwin

CONTENTS.

	Page
CONCLUSION	1
INTRODUCTION	3
LOCATION	3
TENURE	4
PREVIOUS WORK	6
a. Pre - 1980	6
b. 1980 - Diagram Pty. Ltd.	6
c. Post - 1980	8
FINANCIAL STATEMENT	8
REVIEW OF EXPLORATION CONCEPT	9
(1) Potential Source of Tin	10
(2) Weathering History	10
(3) Formation of Placers	11
(4) Preservation of Placers	15
RECOMMENDED EXPLORATION PROCEDURE	18
REFERENCES	22
NOTE ADDED TO PROOF	23

APPENDIX A. Expenditure Statement from C.H. Seawright & Co.

APPENDIX B. Patent Specifications referred to in Appendix A.

Figures.

Fig. 1.	E.L. 1895 - DARWIN HARBOUR, SCALE 1:25000 (in folio)	
Fig. 2.	E.L. 1896 - BYNOE HARBOUR, SCALE 1:25000 (in folio)	
Fig. 3.	Geomorphological development of the Darwin-East area from Van den Broek, 1980.	12
Fig. 4.	Late Quarternary sea levels (from Frakes, 1979 p250)	14
Fig. 5.	Bathymetric contours in the Darwin Area Scale 1:1000 000 (from Van Andel and Veevers, 1967)	16
Fig. 6.	Heavy mineral provinces, Sahul Shelf - from Von Der Borch, 1965.	17
Fig. 7.	Paleogeography of the Timor Sea (from Van Andel and Veevers, 1967.)	20
Fig. 8.	Typical SONIA sub-bottom profile.	21
Fig. 9.	a-d Photographs of Work-boat under construction	24
Fig.10.	General arrangement of Work-boat (in folio)	
Fig.11.	Timor Sea Bouger Anomalies (from Jones, 1969)	25

CONCLUSIONS.

1. The exploration expenditure to date on E.L.'s 1895, 1896 and 1937 has largely been misspent, as few conclusive results were obtained.

2. While there is good scope for offshore alluvial tin concentrations off the North Australian coastline, the areas subject to these exploration licences are probably not the best areas. Too little high energy sediment accumulation is present in the upper reaches of Darwin and Bynoe Harbours. There remains some untested potential in the seaward portions of these licences however.

3. This is not to say that some concentrations of tin do not occur in the upper reaches of both harbours:- it merely means that they are unlikely to be economic for off-shore mining.

4. The areas of most potential lie further off-shore, in Beagle Gulf. There is good evidence that both Darwin and Bynoe Harbours represent the drowned headwaters of Pleistocene river valleys, and that such valleys cut through the capping Mesozoic sediments and Tertiary laterites to expose the underlying Proterozoic bedrocks which contain both cassiterite/tantalite bearing pegmatites and apparently suitable concentrations of tin (estimated at about 5 ppm) in the enclosing sediments and associated late-orogenic granitoids. Thus both a potential concentration mechanism and source would appear to exist in the area.

5. The methods of exploration for such deposits will need to be scientific and systematic. Areas of alluvium must first be defined and then sampled. Techniques are available for this, and have been in use in similar situations in South-East Asia for many years. It would be foolish not to take advantage of such past experience when testing these areas. The recommended procedure will involve shallow seismic surveys to define the channels and sediment profile

sampling along traverses across the channels. Positioning would be controlled by land-based radio beacons. There seems to be no real alternative to this procedure. Thus, there would appear to be little point in persevering with the construction of a survey boat and sub-bottom drill until more is known of off-shore conditions. The initial sampling work should be undertaken by contractors experienced in this field.

6. Because of an apparent lack of suitable source rocks and a greater amount of post-Pleistocene sedimentation in the Shoal Bay area, I conclude that there is little point in retaining E.L. 1937, and suggest it be surrendered.

7. E.L.'s 1895 and 1896 should be reduced in area after discussions with D.M.E. staff on low water mark, in line with the thinking embodied in this report and should be tested as part of the broader survey.

8. Substantial additional off-shore areas in the Beagle Gulf should be secured.

9. The costs of this programme will be notified separately once more detailed discussions with potential contractors have been concluded.

INTRODUCTION.

I have been engaged by Mr. P. Vaggelas, one of the principals of the Exploration Licence Holders, Diagram Pty. Ltd., to prepare an annual report on Exploration Licences 1895, 1896 and 1937, and to recommend a programme for further exploration. This presented some difficulties, since little field work had been undertaken during the current term of the licence due to the fact that attempts were being made to rectify technical difficulties which resulted in the abandonment of the field programme during the 1980 season.

This seems to be an opportune time to review the whole concept of offshore exploration in the Darwin region, and the way in which it has been approached to date. This has resulted in a number of rather major recommendations which, if adopted will result in some change of emphasis in future exploration efforts.

LOCATION.

All areas are located offshore:

* E.L. 1895 covers the upper reaches of Darwin Harbour (East Arm, Middle Arm and West Arm).
* E.L. 1896 covers Bynoe Harbour.
* E.L. 1937 covers Hope Inlet at the mouth of the Howard River.

All are located within a few tens of Kilometres radius of Darwin, though access is best by sea and of course virtually all exploration would have to be ship-borne. All areas are accessible from Darwin Harbour within a few hours by motor launch. The shallowness of some of the areas restricts the type of vessel which can gain access to parts of the licences.

TENURE.

The Western Boundary of E.L. 1895 and the Northern Boundary of E.L. 1896 are Mining Reserves and the contiguous boundary with the exploration licences is defined as the low water mark. Other boundaries to the licence are defined as either the high water mark, or geographic co-ordinates. The definition of these is fairly well established. In the case of the low water mark, however, there is a scarcity of available information in some areas.

In the case of E.L. 1895 (Port Darwin) the most reliable official information seems to be that contained on charts published by the Hydrographic Service, R.A.N.. Charts AUS 27 (1:75000) and AUS 28 (1:25000) refer. However these do not give coverage in the upper reaches of the Harbour and the best available information I could locate was to be found in "Surveys of tidal river systems in the Northern Territory of Australia and their crocodile populations-Monograph 17-Darwin and Bynoe Harbours and their tidal waterways" by Messel et. al. (Pergamon Press (Australia) Pty. Ltd. Sydney) 1981. This contains 1:50000 scale plans which depict the low water mark determined from aerial photographs taken at low -water and from field surveys. This appears to be the best available information on the low water position in the upper reaches of the Harbour and has been used on our plans where R.A.N. hydrographic data is not available. This has resulted in some very substantial changes to the area of the exploration licence to that depicted on Department of Mines and Energy Tenure Maps.The Messel data is in generally good agreement with the R.A.N. data, and unless there is some other legal definition of low water mark to the one employed by these bodies, it would appear that the area of this exploration licence (Fig 1) is substantially larger than was previously believed, and should include some areas of enhanced potential for sub-bottom concentrations of alluvial minerals such as West Arm.

A new plan of E.L. 1896 (Bynoe Harbour) has also been prepared at a scale of 1:25000 (Fig 2). The only published hydrographic chart of this area appears to be the 1:300 000 Charles Point to Pelican Islet chart (AUS 316) of the Hydrographic Service, R.A.N. The data from this chart were enlarged to 1:25000 scale but clearly this is inferior information, because of the small scale, to that presented at 1:50000 scale by Messel et. al. (1981) and gathered in the same manner as described above. We have used the Messel et. al. (1981) Data on Fig 2. The differences with the official tenure maps are not so large in this area because of a generally sharper falloff on the sea floor.

Obviously in both these areas, discussions will have to be held with Department of Mines and Energy to resolve the question of areas that may be retained now that halving of the Exploration Licence is necessary.

Previous Work.

a. pre 1980.

Prior to the work by Diagram, two significant attempts have been made to evaluate the offshore alluvial tin potential in the areas the subject of these Exploration Licences. The most serious of these was the off-shore sampling programme conducted in 1937 on behalf of Anglo-Malayan Development Limited by T.J.B. Donnelly. This covered the upper reaches of both West Arm and Bynoe Harbour, using pontoon-mounted boring equipment. The results seem to indicate quite conclusively that neither sufficient alluvial accumulations or sufficient grades exist to warrant serious testing in the upper reaches of either harbour. This is apparently confirmed by the work of Williams and Layton in the late '60's. They dived to the bottom of West Arm and observed that coarse sediment accumulation was minimal, though the grades they obtained were slightly more encouraging than the earlier Anglo-Malayan results.

Other studies relate to sediment accumulations on-shore and these generally show that, while interesting though not spectacular grades can be obtained in gravels, the channels in which these have accumulated are really quite small, and hardly sufficient to justify the outlay needed for a large-scale dredging operation.

b. 1980 - Diagram Pty. Ltd.

The fieldwork to date performed by Diagram Pty. Ltd. is described in the "Annual report to Department of Mines and Energy - Northern Territory of Australia for Exploration Licences 1896, 1895 and 1937" by D.R. Kershaw.

All fieldwork reported was on E.L. 1896. No results are available from the other areas. This records available drilling results. It would appear that the Kershaw report merely formalizes the work of others as there is little in-depth discussion of the reasons for the apparent failure of the drilling technique and the lack of a proper record for the majority of drillholes and samples. Water depth and sample depth are recorded for virtually all samples, but lithologies encountered and the reason for the abandonment of the hole are recorded for only about half the samples, while assay results are available for only about 30 of the 88 holes.

It is not difficult to imagine that a reverse circulation submarine drilling technique might result in a large handling problem because of excessive water flows. It is more difficult to understand why there are no sample results for most of the programme. It would appear that these samples are no longer available. If this is the case, the sampling programme is to be regarded as at best inconclusive, and I find it difficult to add any meaningful conclusions to those drawn by Kershaw.

A comparison between the results of the hydrographic survey and the water depths encountered in the drilling programme indicate that there is poor definition of the bottom topography in either survey. Even if the sample data referred to above were available it would be difficult to interpret the information in any systematic fashion since there would appear to be a large random element in drill site location procedure: sample sites on section lines across the harbour would have allowed more to be extracted from the data.

There are little data available in the deeper parts of the channel, especially further out into the harbour. It is here that one might imagine that reasonable developments of gravels might be present if these are related to the present tidal and hydrographic regime. This potential remains largely untested by the work to date. The conclusions drawn by Kershaw and the earlier workers that insufficient concentrations in terms of volume and grade are present in the upper reaches of Bynoe Harbour appear justified, and it is hard to recommend that further work be undertaken in this area, despite the shortcomings of the work.

c. Post 1980.

As a result of the poor performance of the drilling equipment and vessel, the vessel was disposed of locally and plans were implemented for the construction of a new integrated vessel and drilling equipment. This work has been in progress throughout the 1981 season, and as a result no field activity occurred.

Photographs of construction progress on the vessel are included as Fig. 9a-d & Fig 10. A summary of expenditure which it is considered reasonable to regard as expenditure on Exploration on the area is shown in the Financial Statement below, and Appendix A.

It is indeed tragic that such a large expenditure on these areas to date has produced so little conclusive data. I believe I should try here to suggest ways of salvaging what was a grand concept which has gone badly astray.

FINANCIAL STATEMENT

Appendix A, prepared by C.N. Seawright and Co., Chartered Accountants, records a total expenditure during the term of the licences of $77,631. Total expenditure committments for the three areas was $60,000 ($20,000 each).
Previous reported expenditures (Kershaw, 1980) were:-

E.L. 1895	$ 21,400
E.L. 1896	$288,200
E.L. 1937	$ 20,000

Thus total expenditure on these areas to the end of the second term of the exploration licences has been $407,231.

Review of Exploration Concept.

Tooms (1970) (See Hails, 1976) classifies marine placers into four main types:-

1. Submerged alluvial placers.
2. Eluvial deposits resulting from the weathering of underlying bedrock lodes.
3. Drowned beach and dune heavy mineral deposits.
4. Marine placer deposits.

Tin occurs primarily in offshore deposits in the first of these (Emery and Noakes, 1968), though smaller deposits of other types are likely to occur in the Darwin area, and are probably the cause of the numerous tales of tin in marine sediments in Darwin and Bynoe Harbours.

The main world source of tin is the south-east Asian tin belt, from Burma through Malaysia and Thailand to Indonesia. In this area there are few primary lode deposits of any significance. The huge alluvial concentrations are the product of weathering and surface concentration of rocks with high-trace tin contents. Aleva et. al. (1973) believe that primary mineralization with a cassiterite content as low as 1-10 ppm may lead to tin deposits of economic importance provided the process of concentration is favourable.

The factors which are considered favourable are:-

(1) High concentration of tin granite
(2) Deep and rapid tropical weathering
(3) The formation of marine and alluvial placers (usually in earlier periods of erosion).
(4) The preservation of such placers resulting from relatively low terrain drained by low-velocity streams.

The concept that large secondary tin deposits are not truly alluvial but are residual-elutriational relates, but need not be considered in detail here. We should discuss the local situation in relation to these factors.

(1) POTENTIAL SOURCE OF TIN.

The Bynoe/Finniss/West Arm tinfield is the obvious local source for tin in offshore alluvial concentrations. This North-South trending belt contains numerous small pegmatite lenses in metamorphosed phyllite and greywacke country rocks of the Proterozoic Burrell Creek Formation. I have heard rumours that similar mineralized pegmatites exist in the more high-grade metamorphic terrain to the west though exposure of this is poor, and few if any have been worked. Much of the metasediment close to pegmatites in this region carries traces of cassiterite, and Ferguson's (1980) work suggests that the average tin content which might be expected in sediments and late granites in the Pine Creek Geosyncline is about 5 ppm. In any event, it seems likely that a substantial volume of rock (not necessarily granite) with an average cassiterite content in the range 1-10 ppm would be present in this tinfield. It also seems likely that this mineralized belt extends north of the coastline, out into Darwin Harbour and probably Beagle Gulf. This is suggested both by the strong North-South trend demonstrated by the mineralized zone on land, and the extension of the weak gravity low* which corresponds with this zone into the sea in that area. Thus, while a high concentration of tin granite in the area may be lacking (and this is by no means certain especially on the west side of Cox Peninsula) a potentially anomalous source rock for tin appears to exist.

(2) WEATHERING HISTORY.

The area occurs at about the same latitude south as southern Thailand is north and has undoubtedly been subjected to similar chemical weathering conditions as the tin areas of South-East Asia. The most intense period of tropical weathering probably ocurred during the early Tertiary (Cenomanian to Miocene) lateritization event which affected both areas. The weathering and geomorphological history of the Darwin area is summarized in Fig

* See Note added to Proof. p.23.

3 (from Van den Broek, 1980). Clearly a cap on top of the source rock could prevent deep weathering either chemical or mechanical. Two local features should be noted here:-

a. A great part of the local terrain is covered by a thin veneer of Cretaceous (or Jurassic) sediments. Areas which are still covered by such sediment could not provide tin for any Post-Cretaceous alluvial concentrations, which are likely to be the main targets.

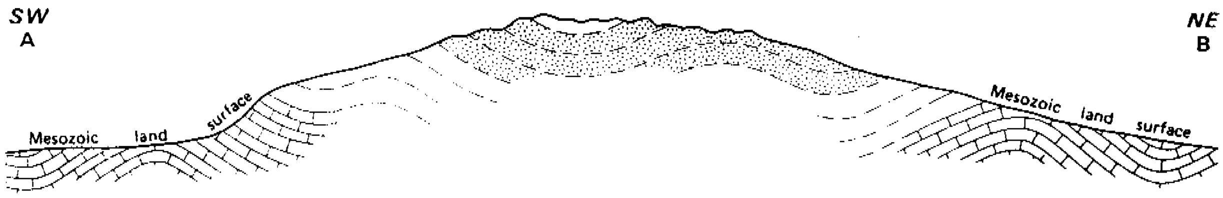
b. While the weathering process of laterization produces deep intense weathering suitable for liberating cassiterite from its primary source, it also results in a resistant near surface capping of iron oxides and hydroxides. Since the major period of laterization was in the early Tertiary (Fig 3), areas of Proterozoic bedrock capped by laterite are unlikely to have been significant sources for post-Miocene alluvial concentrations unless this capping has been removed. A review of available mapping shows that has happened only on restricted areas of the present land-surface, though more detailed mapping is needed to quantify this.

3. FORMATION OF PLACERS.

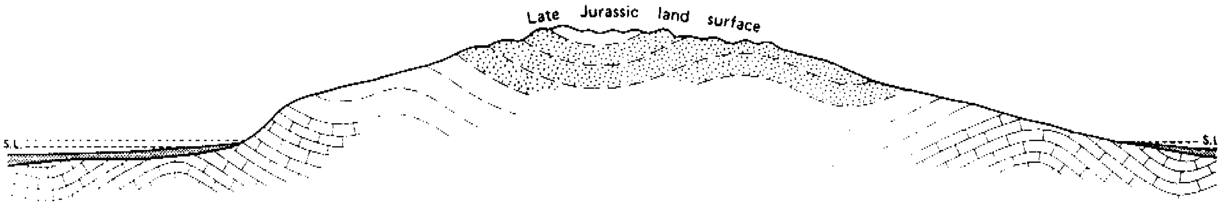
There is little evidence on the land surface of the formation of placer deposits of substantial size. Most on-shore alluvial deposits are of very limited extent down-stream from their sources, and are probably little more than soil-creep on eluvial concentrations. Most important offshore deposits in such places as the Indonesian Tin Islands are found in submerged river channels of glacial or post-glacial age. This is because during glacial periods, the sea level is much lower (Fig 4). On average during the Pleistocene glacial ages, the world wide sea level was 150 m below its present level, usually at around the edge of today's Continental Shelf. During the Pleistocene sea level lows, intense erosional activity would have occured, especially on a surface deeply weathered by a period of laterization as occured in the preceding Tertiary. This would have resulted in major stream formation, but the

Fig. 3.

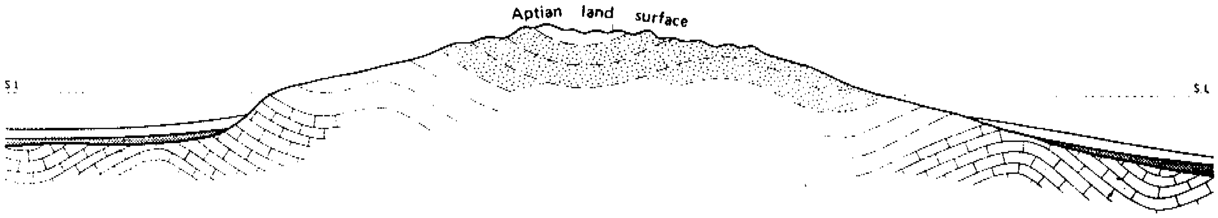
1. Middle Jurassic land surface
Land area – folded and eroded Lower Proterozoic rocks; mature landscape



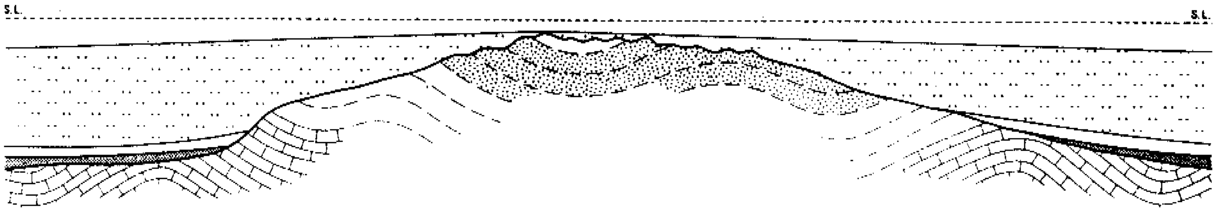
2. Late Jurassic – Neocomian
Unconformable deposition of coarse-grained, friable, quartz sand (Petrel Formation). High-energy environment, transgressive sea; shoreline, marine, and fluviatile conditions



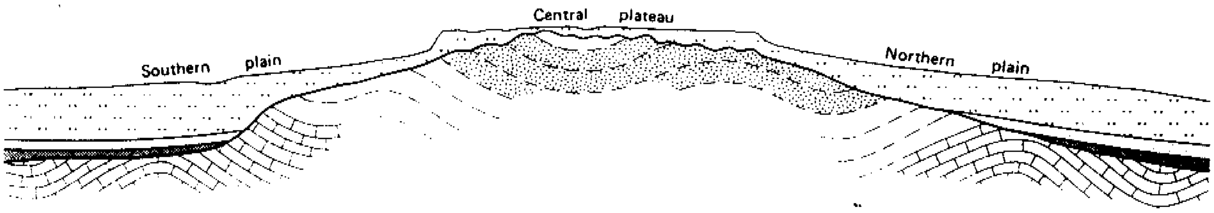
3. Early Cretaceous (Aptian)
After a brief regression, locally unconformable deposition of fine-grained quartz sand (lower unit of Darwin Member). Medium-energy environment, transgressive sea; near-shore marine



4. Early Cretaceous (Aptian)
Conformable deposition of radiolarian silt (upper unit of Darwin Member). Low-energy environment; offshore marine

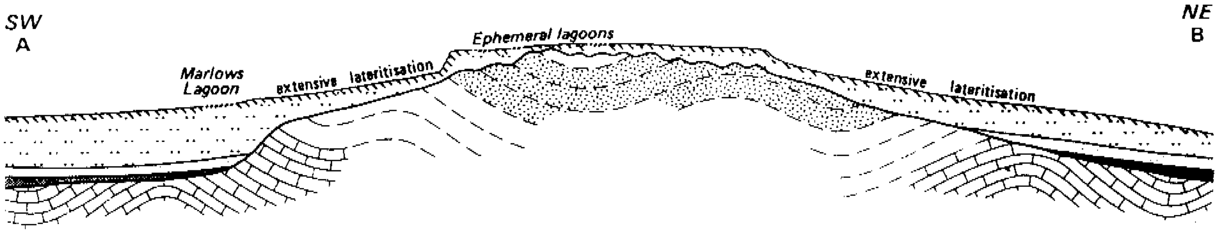


5. Early Cretaceous (Albian) land surface
Uplift, and erosion by pediplanation. Major landscape-forming event; minor internal drainage; formation of subsidence dolines and basin-like depressions

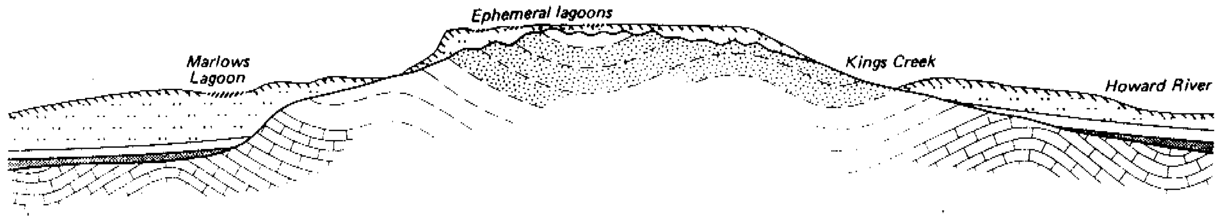


Geomorphological development of the Darwin East area

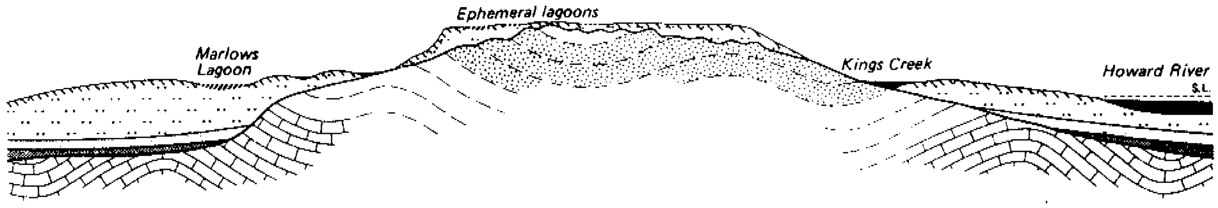
6. Late Cretaceous (Cenomanian) to middle Tertiary (Miocene) land surface
Lateritisation, major chemical weathering event; minor landscape-forming event; formation of the standard lateritic profile; filling of dolines with lateritic clay; formation of lagoons



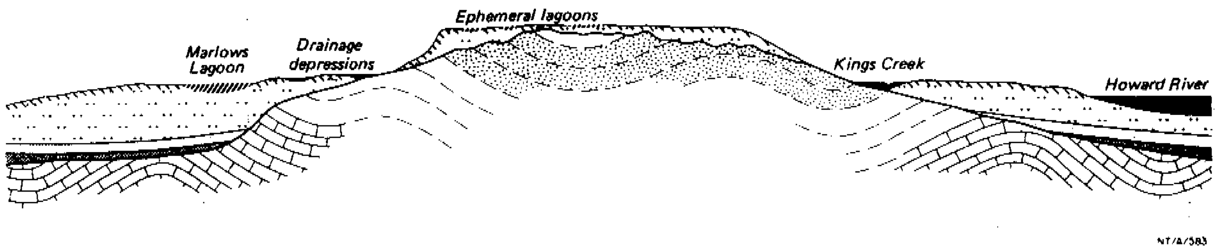
7. Middle to Late Tertiary (Miocene to Pliocene) land surface
Erosion by fluvial processes; major landscape etching; lowering of base (sea) level; cooler climate; formation of broad drainage channels

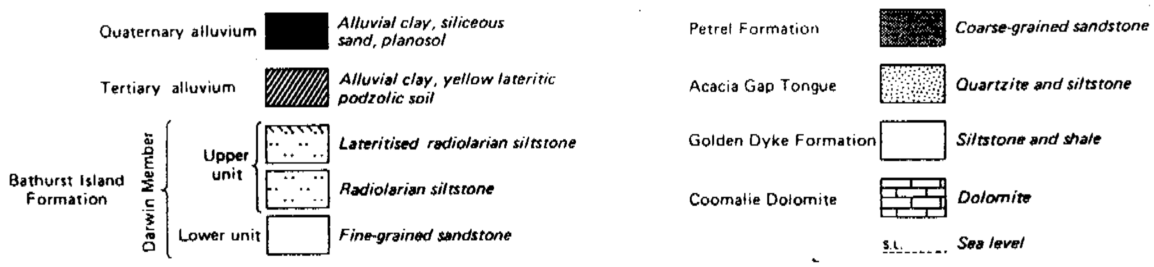


8. Quaternary (Pleistocene) land surface
Deposition by fluvial, colluvial, and aeolian processes; major rise in sea level; formation of laterite in seasonally flooded areas; drowning of river mouths; deposition in estuaries and broad drainage channels



9. Quaternary (Recent)
Minor erosion by fluvial processes; minor fall in sea level; slight cooling of climate; formation of estuarine swamps





based on a diagrammatic section through line A-B

Fig 4.

250

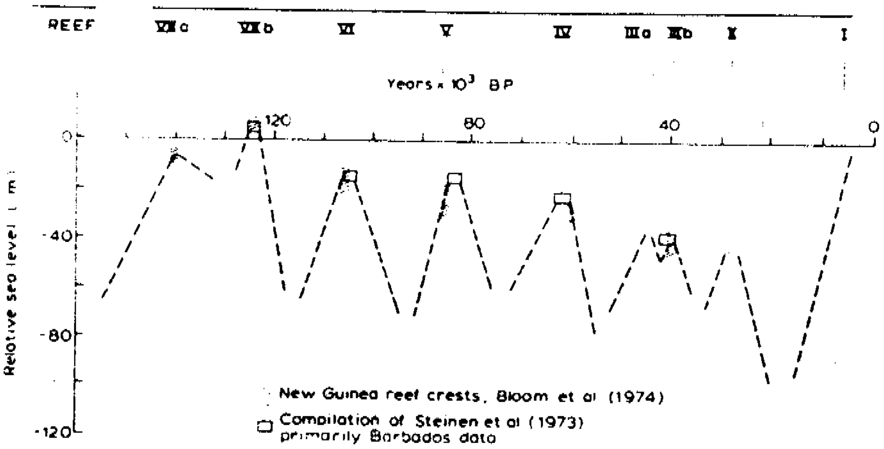


Fig. 8-12. Late Quaternary sea levels estimated from marine shorelines in Papua-New Guinea, Barbados and elsewhere. Roman numerals refer to sea-level stages. Modified from Bloom et al. (1974).

evidence for these is probably now largely submerged on the sea floor. In this regard it is worth noting the similarity in form of both Darwin and Bynoe Harbours to drowned valleys: To me they resemble the headwaters of major streams. There is little evidence that these stream systems extended much further inland as major streams than the present tributaries to the harbours, but there is cause to believe that substantial streams may have had their headwaters in the Darwin and Bynoe areas (ie. over the Tin Belt) and drained to the north.

Fig 5 shows the bathymetric contours of the sea-floor north of Darwin as far as the edge of the continental shelf (from Van Andel and Veevers, 1967). There is a clear suggestion that the channels running from both harbours could represent major Pleistocene streams. When we examine the bottom sampling information, (eg. Jones and Burgis, 1974; Van Andel and Veevers , 1967) the coincidence of these channels with zones of coarse terrigenous sediment adds further weight to the speculation. Studies of heavy mineral contents in the bottom sediments of the area (Von der Borch, 1965; Fig 6) show a strong association with the most common accessory minerals of the Darwin area, including much tourmaline, a frequent associate of cassiterite in the pegmatite bodies, which might suggest that a tin source has indeed been eroded* and that cassiterite should be present in any situations suitable for trapping it which exists in the area. Clearly the supposed Pleistocene stream channels should fit this model. Fig 7 illustrates Van Andel and Veevers' (1967) reconstructions of the palaeogeography of the region.

4. PRESERVATION OF PLACERS.

While I have not sufficiently studied post-Pleistocene sedimentation rates in the area in question, it would appear that the rate of sedimentation since the end of glaciation and subsequent sea level rise has been lower in this zone than on some other parts of the N.T. coastline.

* The heavy mineral suite associated with the Darwin area is said to reflect mature weathering conditions (necessary for

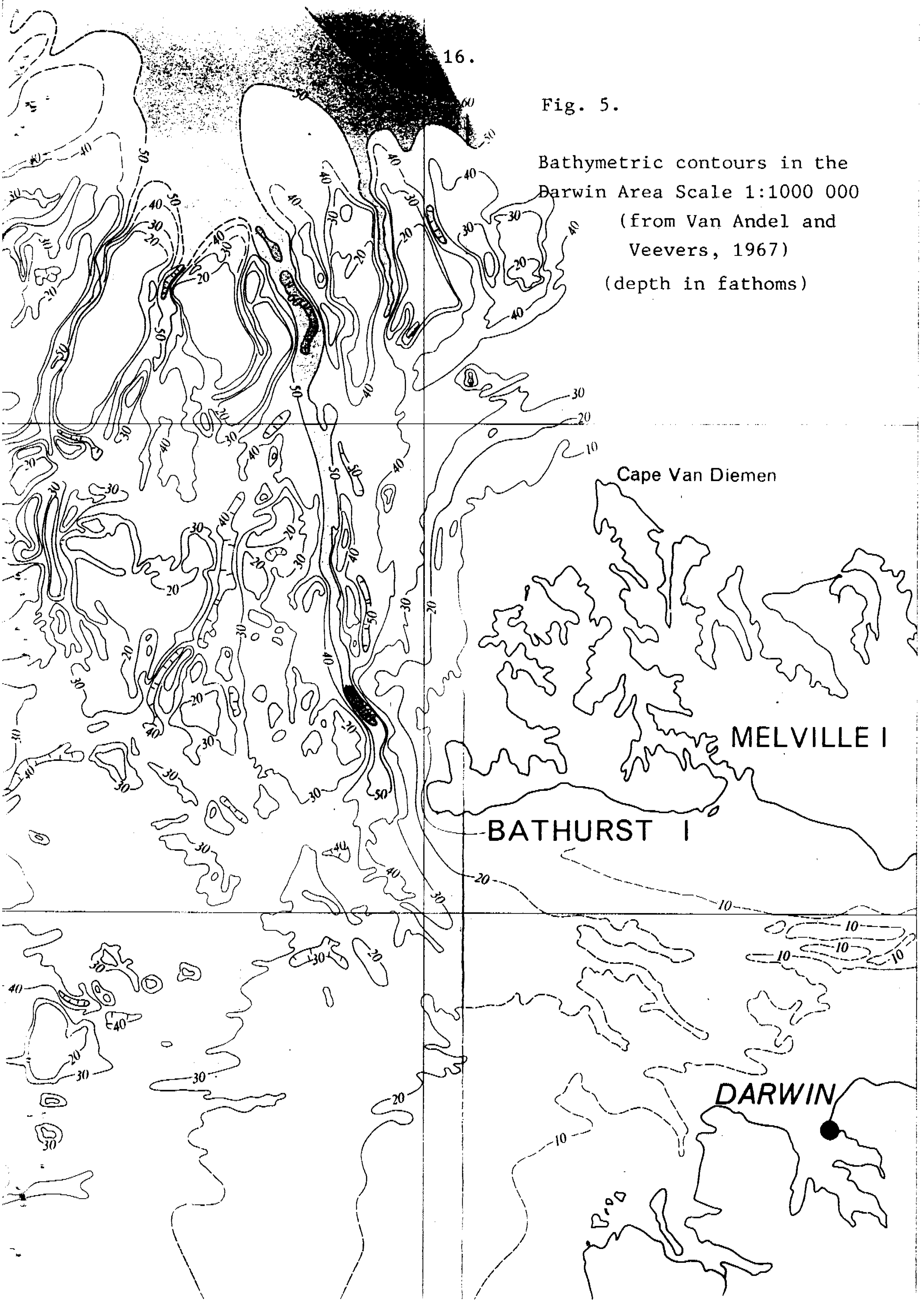


Fig. 5.

Bathymetric contours in the Darwin Area Scale 1:1000 000 (from Van Andel and Veevers, 1967) (depth in fathoms)

Fig 6.

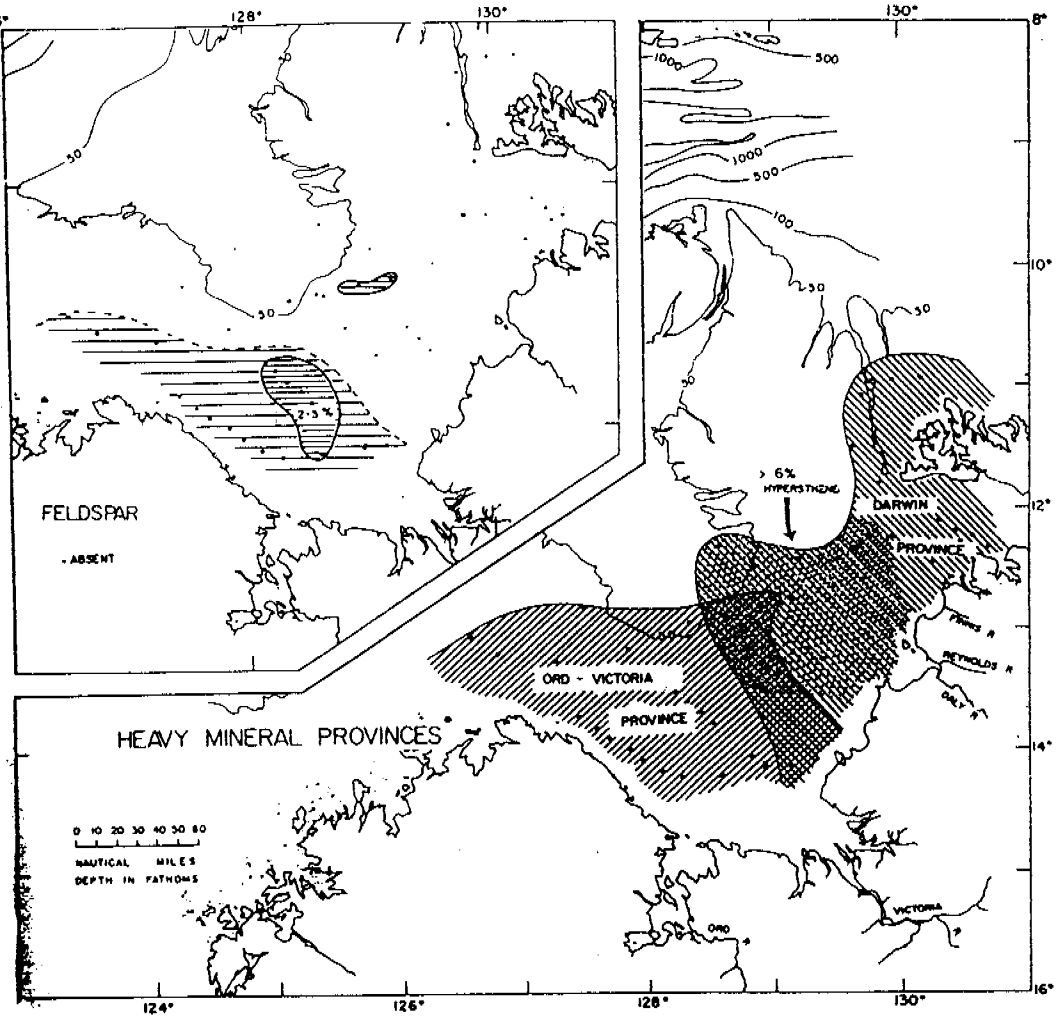


Fig. 8.4—Heavy mineral provinces and distribution of feldspar (in percent of the terrigenous fraction of the 2.0-0.062 mm size grade) in the surface sediments of the Sahul Shelf. The area with more than six percent hypersthene in the heavy fraction is shown with dotted pattern. Map based on data from von der Borch (1965). Insert: Small dots are samples without feldspar.

Clearly the criteria of low relief drained by low velocity streams (see above) exist, but there would appear to be other complicating factors around the coast, and further information is required. However there is cause for optimism that this area is one of low post-Pleistocene sedimentation, which should result in fairly thin overburden over the high energy Pleistocene accumulations most likely to host tin deposits on the sea floor.

Recommended Exploration Procedure.

The idea of sailing out to sea and unreliably sampling the bottom at random with the hope that a tin deposit might be discovered is a very long-odds lucky dip. That, frankly, sums up the previous exploration programme.

To successfully delineate an economic tin concentration on the sea floor, it will be necessary to conduct a much better controlled and systematic programme involving high technology. I believe that the only sensible approach to this work is as follows:-

1. Select and secure a large area using available data.
2. Complete a thorough review of all available data from all sources (eg. Navy , Petroleum Exploration, Indonesian Experience etc.)
3. Plan and implement a reconnaissance sub-bottom seismic profiling survey of the SONIA type to confirm or negate the concept of Pleistocene alluvial channels. This should be combined with a ship-board magnetic and gravity survey to attempt to more clearly define the extension of the potential tin source zone through the area, for it is probably unlikely that great volumes of cassiterite were removed from the now on-shore pegmatite belt (see above). A better source would be that part of the belt now offshore, where Cretaceous and laterite cappings have probably been stripped and the underlying rocks heavily eroded during the ice ages. Thus the most favourable zone for search appears to me the possible Pleistocene Channels down-stream

from their intersection with the pegmatite-bearing belt offshore, though there would still be some potential up-stream from this from erosion of areas still now on-shore.

This survey should run lines parallel to the coast from the harbours to Bathurst Island, with lines spaced perhaps 5 km apart. The survey should be positioned by shore based radio beacons. The survey should produce information such as that depicted in Fig 8.

4. The reconnaissance survey should reveal whether sufficiently large alluvial gravel concentrations are present within practicable dredging depths and with acceptable overburden. If this is the case, the fossil placers should be detailed by closing up the survey to say 1 km over favourable areas.
5. In conjunction with the more detailed sub-bottom profiling, reconnaissance sampling of the wash should commence. I am reluctant to recommend the exact nature of this sampling procedure until I have more details of what is available from contractors, and what methods are currently employed for sampling in the South-East Asian off-shore areas. There seems little point in re-inventing wheels when perfectly good ones probably exist already. In these circumstances it is difficult to recommend a continuation of work on an in-house survey vessel and drill at present. It would be far more successful and economical to put available systems to the test on contract before deciding on a design for in-house equipment.
6. If the results of this are promising, the programme should extend to detailed sampling of the alluvium. At this stage ones own vessel and drill could well be warranted.

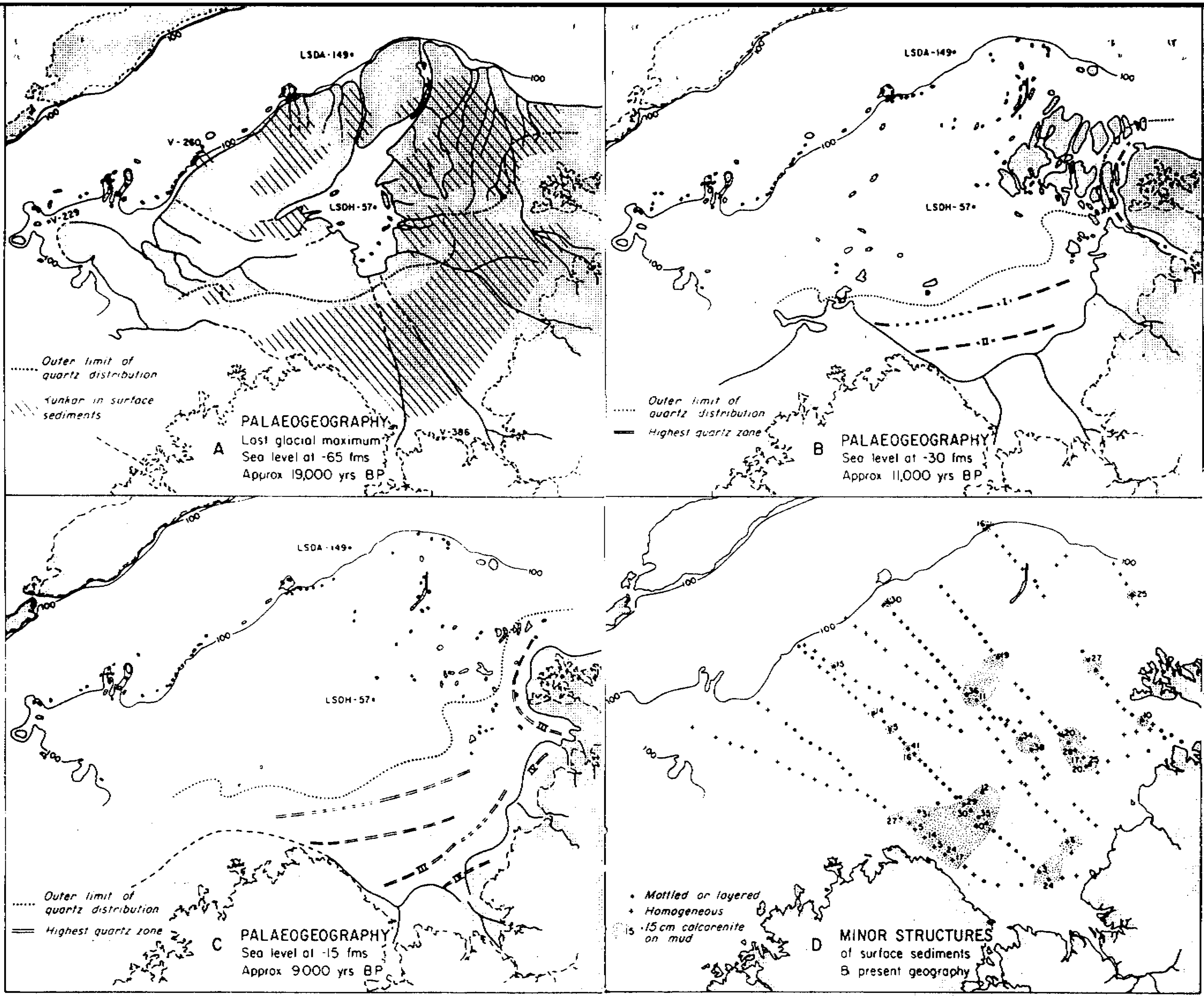
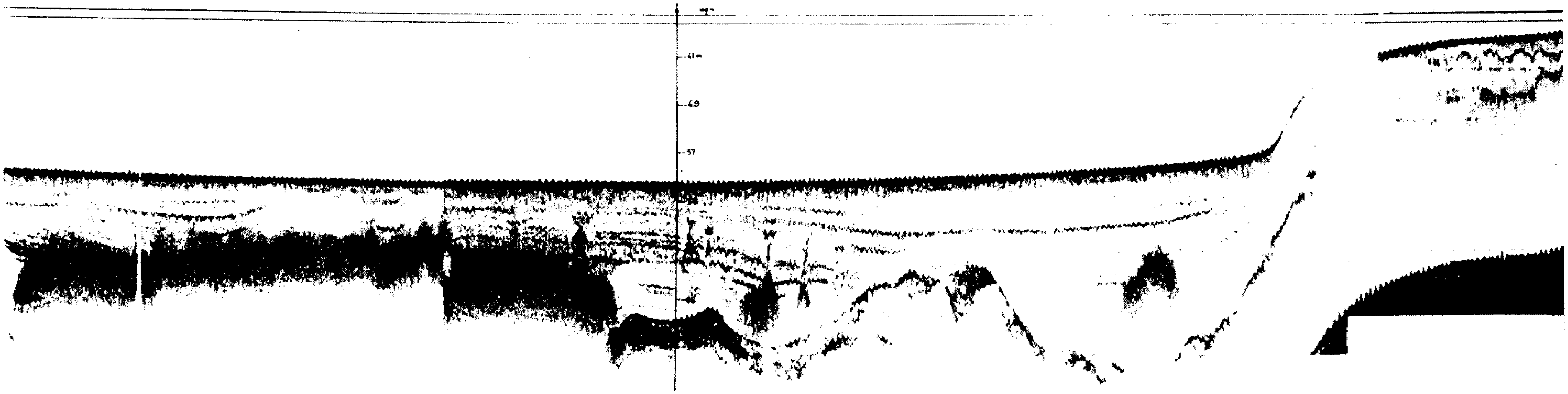


Fig. 11.1—Palaeogeography of the Timor Sea during the last glacial maximum (A) and two stages of the postglacial sea level rise (B, C). Dates for sea level positions after Curray (1960). Locations of critical long cores are shown. Distribution of kunkar (brown calcareous nodules) falls entirely within land area exposed at lowest sea level. Zones of maximum quartz concentration (numbered in order of decreasing depth, after Fig. 8.3) parallel former shorelines. Lower right: map (D) shows distribution of sedimentary structures and of coarse calcarenite sheets on the Sahul Shelf. Scale approximately 1 : 8,000,000.

Fig. 7.

20.



Pleistocene valley, Botney Cut. (North Sea)

Sonograms showing Pleistocene alluvial
and marine deposits covering Paleozoic bedrock, Indonesia.

(Time intervals indicate 10 msec.)

Fig 8. 21.

REFERENCES

Aleva,G.J.J., Fich,L.J., Krol,G.L. (1973) * Some remarks on the environmental influence on secondary tin Deposits. B.M.R. Bull. 141,pp163-172.

Emery, K.O. and Noake,L.C. (1968) * Economic Placer Deposits of the Continental Shelf. Tech. Bull. E.C.A.F.E. 1:95-111.

Ferguson, J., & Winer, P., (1980) * Pine Creek Geosyncline: Statistical treatment of whole rock chemical data, in Ferguson,J. (ed) Uranium in the Pine Creek Geosyncline, I.A.E.A., pp191-208.

Frakes, L.P. (1979) * Climates throughout Geologic Time. Elsevier.

Hails,J.R. (1976) * Placer Deposits in Wolf, K.H. (ed) Handbook of Strata-Bound & Strati-form Ore Deposits, Vol.3 Elsevier.

Jones H.A., & Burgis W. (1974) * Timor Sea Continental Shelf Sediments Map B.M.R. Bull. 83.

Tooms J.S. (1970) * Some aspects of exploration for Marine Mineral Deposits in Jones, M.J. (ed) Mining and Petroleum Geology-proc. 9th Comm. Congr. IMM London, pp285-296.

Van Andel, T.H. & Veevers, J.J. (1967) * Morphology and Sediments of the Timor Sea. B.M.R. Bull. 83.

Van den Broek, P.H. (1980) * Engineering Geology of Darwin East, N.T. B.M.R. Bull. 203.

Von Der Borch, C.C., (1965) * Distribution of Detrital Minerals in recent Carbonate Sediments from the Sahul Shelf, Northern Australia, J. Geol. Soc. Aust. 12 (2): pp 333-339.

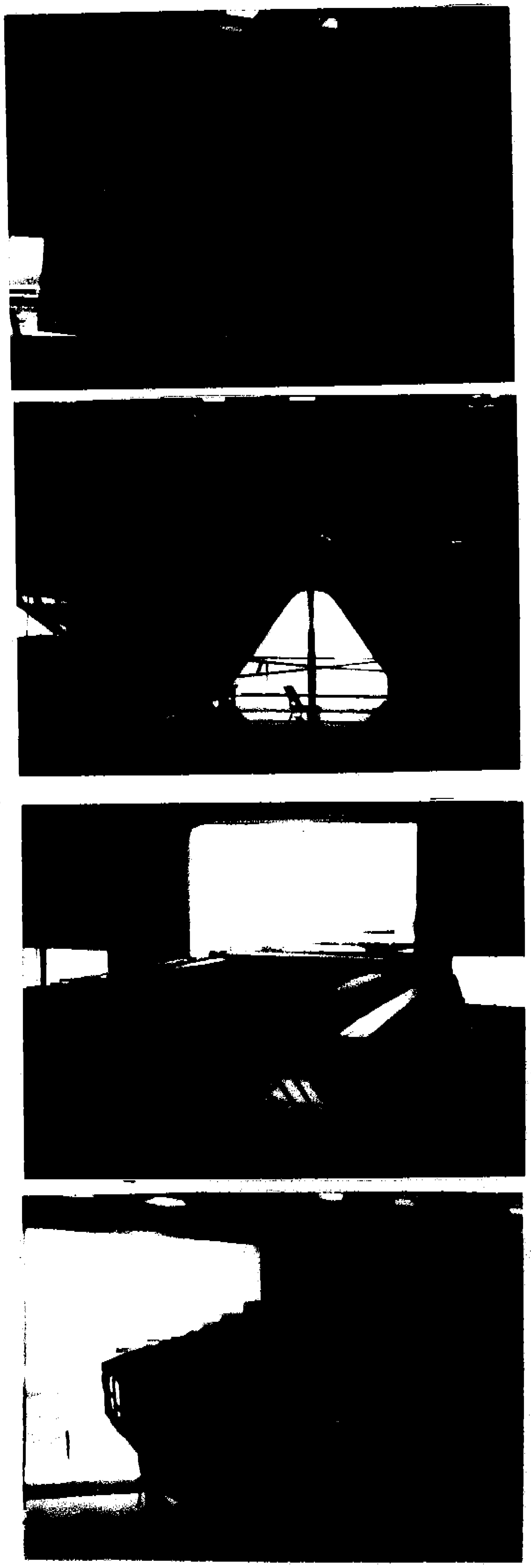
NOTE ADDED TO PROOF

The Bynoe tin belt appears to be associated in detail with a north-south trending shoulder in the gravity contours. This is truncated about 15 km offshore of Darwin by a gravity high, which at first glance tends to suggest that the gravity trend does not persist. However, if we look at the broader gravity picture (e.g. 1:5,000,000 Gravity Map of Australia; B.M.R Record 1969/40 - Fig. 11), the trend would appear to continue to the north of Melville Island. Currently available on-shore information leads me to suggest that the apparent truncation of the shoulder/low by a gravity high is due to a large thickness of Lower Proterozoic carbonate (Coomalie Dolomite) present in that area. The gravity high to the east of Darwin (in the Koolpinyah area) is almost certainly attributable to this dolomite, and available guidence suggests that this is the most likely explanation of at least the northern part of the Wangites Regional Gravity Ridge (Fig. 11) in the Bynoe Harbour area - carbonates outcrop around the shores of Bynoe Harbour. If the local truncation of the gravity trend associated with the tin-belt is in fact due to carbonate, it could be that

(1) A favourable topography for alluvial concentrations may be developed in Beagle Gulf.

(2) Equally favourable depositional conditions for primary mineralization may exist on pegmatite/carbonate contacts offshore to those which exist in Burrell Creek Formation / Pegmatite contacts on land.

Thus, while the gravity trend associated with the Bynoe tin belt does appear to be truncated by a gravity high just to the north of Darwin, if the reasons given above for this are correct, it does little to detract from the concept advanced in this report.



a

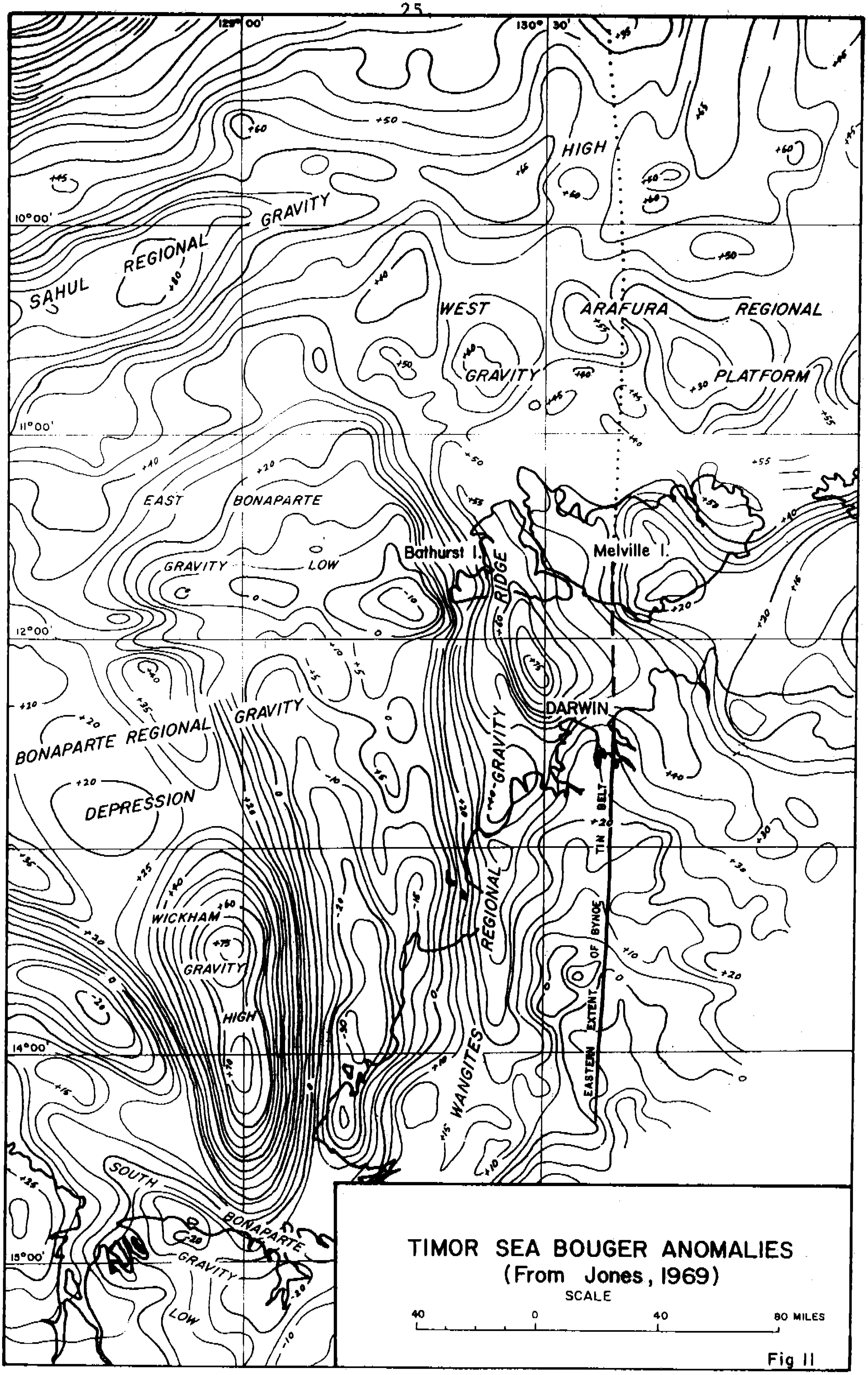
b

c

d

Fig. 9

Photographs
of new work-boat
under construction



TIMOR SEA BOUGER ANOMALIES
(From Jones, 1969)

Fig 11

APPENDIX A.

EXPENDITURE ON E.L.'S

1937,1895 and 1896.

Prepared by

C.N. SEAWRIGHT AND CO.,

CHARTERED ACCOUNTANTS.

2nd March, 1982.

Details of Expenditure Incurred

Expenditure incurred during the twelve month period to September, 1981 on research exploration and development activities related to Exploration Licences 1937, 1895 and 1896 can be summarised as:-

	$
Consumable Stores, Tools, Materials	9,153
Wages	31,274
Overheads	6,146
Depreciation	4,623
Travelling Expenses	5,000
Naval Architects Fees	6,000
Lease of Equipment	15,435
	$77,631

Consumable Stores, Tools and Materials are direct costs during the period. Details of the remaining items are set out hereunder:-

Wages

Two employees - Mr. David Vaggelas and Mr. T. Kruck were involved in the modification to the drills and in the design, in conjunction with a Naval Architect of the new boat to carry out exploration work. It is estimated that 75% of their time has been involved in this work. Salaries paid to them are:-

D. Vaggelas	$398 per week:	per annum	20,696
T. Kruck	$331 per week:	per annum	17,212
			$37,908

Total wages allocated are:-

Wages paid - as above	$37,908
75% =	28,431
Add Payroll Tax, Workers Compensation, Holiday Loading - say 10%	2,843
	$31,274

Overheads

Total overheads (after excluding items directly related to other than lease development expenditure) incurred in the twelve month period to June, 1981 were as follows:-

	$
Bank Charges	726
Cartage	721
Electricity	428
Fuel and Oil	2,236
Licences and Registration	1,289
Legal Fees	120
Motor Vehicle Repairs	1,957
Plan Printing and Stationery	2,152
Repairs Plant	325
Repairs Equipment	473
Sundry Expenses	148
Security Charges	2,289
Telephone	4,137
	$17,001

C. N. SEAWRIGHT & CO.
CHARTERED ACCOUNTANTS

18TH FLOOR
CITY MUTUAL BLDG.
307 QUEEN STREET
BRISBANE 4000

G.P.O. BOX 662
BRISBANE 4001
TELEPHONE 221 4888
A/H. 353 1194
TELEX 42859

C. N. SEAWRIGHT, F.C.A.

2nd March, 1982.

Mr. G.S. Eupene,
111 Smith Street,
DARWIN, N.T. 5790.

Dear Geoff,

re: Disport Pty. Ltd.
Diagram Pty. Ltd.

We have been asked by Mr. P. Vaggelas to provide you with certain information regarding expenditure incurred by his companies which is directly related to Exploration Licences 1937. 1895 and 1896.

The expenditure set out hereunder was incurred by a company, Offshore Prospectors Pty. Ltd. which is jointly owned by Mr. Vaggelas and his Son. A charge was made to Diagram Pty. Ltd. by Offshore Prospectors Pty. Ltd. for work carried out during the year ended 30th June, 1981 representing costs incurred together with a profit margin. A charge will also be made to Disport Pty. Ltd. during the current financial year in respect to work carried out and relating to that company's interest in the above licences. The charge to Disport will relate to work carried out both prior to and subsequent to June, 1981. The expenditure listed below represents costs as incurred and does not contain any profit content included in the recharges made or to be made against Diagram Pty. Ltd. and Disport Pty. Ltd. The items listed all were incurred during the period October, 1980 to September, 1981, except where otherwise mentioned,

Nature of Work Carried Out

Work carried out by Mr. Vaggelas during the period under review in connection with his lease development fell into two main areas:-

(a) Boat

The previous boat owned by Mr. Vaggelas and used by him for exploration work in his areas did not prove suitable. It was basically a trawler hull and suffered the disabilities of excessive roll and draft. Mr. Vaggelas found it necessary to withdraw that boat from service and to design a new boat presently under construction. The new boat is a twin-hull design giving the advantages of stability and shallow draft. Enclosed are copies of the plans of the boat, together with photographs of the boat under construction.

(b) Drills

Mr. Vaggelas had, prior to the period under review, purchased from Mr. E. Braumann certain patents over the design of drilling equipment considered suitable for the work to be carried out on Mr. Vaggelas' leases. During the period that Mr. Vaggelas used this equipment for exploration purposes, the drills proved to be inadequate for the work required, and it was found necessary to carry out major rectifications to the design of the drills. The drills have been modified several times by Mr. D. Vaggelas and Mr. T. Kruck, and further development work is continuing in this area. Plans of the drills are attached.

2nd March, 1982.

	$
Land Cruiser	6,227
Table, Keyless Drill Chuck, Drilling Machine, Band Saw	3,278
Lathe	5,730
Equipment on Hydrofield	4,176
	$19,411

With the exception of the Land Cruiser, the above items were used almost exclusively for the work on the drilling equipment. Accordingly, the lease payments allocated to the exploration licences are as follows:-

Table, Keyless Drill Chuck	3,278
Lathe	5,730
Hydrofield	4,176
Land Cruiser (36.15% as for overheads)	2,251
	$15,435

We trust that the above information is suffioient for your purposes. Should further information be required, we will be pleased to assist.

Yours faithfully,
C.N. SEAWRIGHT & CO.

Per:

2nd March, 1982.

The above expenses are of a constant nature and it would be reasonable to assume that the expenditure in the twelve months to September, 1981 would approximate the figure for the twelve months to June, 1981.

The above expenses have been apportioned to lease development as under on the basis of wages attributable to lease development as a proportion of total wages:-

Total Wages Paid	$78,645
Attributable to Lease Development:-	$28,431
or	36.15%

Overheads attributable to Lease Development:-

36.15% of $17,001	=	$6,146

Depreciation on Equipment

Depreciation incurred on items of plant and equipment directly involved in lease development activities for the year ended 30th June, 1981 was as follows:-

	Value 30.6.80	Rate %	Depreciation
Equipment for Boat:-			
Crane	3,083	11¼	347
Drill	11,009	11¼	1,238
Air Compressor	1,308	11¼	147
Pump	1,252	11¼	141
Pontoon	498	11¼	56
Rollers	678	11¼	76
Small Boats			
Mako	7,595	11¼	853
Hydrofield	11,346	11¼	1,275
Machinery			
Lathe	5,031	9	452
Ball Press	428	9	38
			$4,623

Travelling Expenses

Mr. Vaggelas made two trips to Darwin during the twelve months which were directly related to lease development. One trip was to seek partners to explore and develop his leases, the other to appoint yourself in your present capacity. Each trip is estimated to have cost $2,500.

Naval Architects Fees

Fees paid to A.S.D. Marine Pty. Ltd. for work done on the design and plans for the new boat amounted to $6,000.

Lease of Equipment

Leasing charges incurred by Offshore Prospectors Pty. Ltd. during the period were:-

APPENDIX B.

Patent Specifications referred to in Appendix A.

408715

THIS INVENTION relates to a new and improved earth drilling unit, particularly suited to soft drilling through earth, sand, silt and soft stone such as shale or sandstone.

The general object of the present invention is to provide a drilling unit which will greatly facilitate drilling, for example for the purpose of forming a shot hole such as may be required in making seismic surveys, or for the purpose of procuring for analysis samples of material at selected depths below the earth's surface or the seabed.

Accordingly, the invention resides broadly in an earth drilling unit for producing a core of drilled earth, including a first tube, a second tube mounted coaxially within said first tube and sealed thereto to form an annular space able to be pressurized, an annular cutting bit attached to the lower end of said first tube, a vibrator attached to the upper part of said first tube to impart to said tube and said bit a vibration substantially in the direction of the longitudinal axis of said tubes, means for directing fluid under pressure into said annular space, and jet passages for said fluid passing from said annular space into the interior of said second tube.

Other features of the invention will become apparent from the following description of an embodiment shown in the drawings, in which

FIG. 1 shows a drilling rig in part section

FIG. 2 shows on enlarged scale the drill and

FIG. 3 shows a modified bit.

(11) 408715

COMMONWEALTH OF AUSTRALIA

PATENT SPECIFICATION (21) 67,403/65

Class (52) 85.2; 85.4.

Int. Cl. (51) F21b; G21c.

Application Number (21) 67,403/65.
Lodged (22) 2nd December, 1965.
(Accompanied by a Provisional Specification)

Complete Specification entitled (54) A NEW AND IMPROVED DRILLING UNIT.

Lodged (23) 2nd December, 1966.
Accepted (44) 4th December, 1970.
Published (41) 6th June, 1968.

Convention Priority (30) -

Applicants (71) ERIC CLIFFORD BRAUMANN, FREDERICK WILLIAM REICHELT and CHARLES BRUCE HOPE.

Actual Inventor (72) ERIC CLIFFORD BRAUMANN.

Related Art (56)

137,851(11,812/47)	85.8; 85.4
164,953(25,965/54)	85.4; 85.9
256,314(20,567/62)	85.4; 65.3.

The following statement is a full description of this invention, including the best method of performing it known to us :

91-2D-28/1/71-10P. C.

towards the axis of the inner tube.

A fluid inlet 25 leads into the annular space 19 between the outer and inner tubes 17, 18, and a hose 26 for air, or water, or a mixture of air and water, is connected at one end to this inlet by any suitable means, being connected at the other end to a mixing valve device 27 to which air and water under high pressure may be conducted, valve 27 being usable to direct air or water or both in desired proportions and under high pressure to inlet 25 by way of hose 26.

A high frequency vibrator 28 is mounted fixedly on the upper end of the drill string 14. Vibrator 28 may be of any suitable type, such as, for example, a body, the lower part of which is in the form of a clamp 29, clamped onto the upper end of the outer tube 17, the upper part of the body having formed therein a cylinder 30 co-axial with the outer and inner tubes 17, 18. A piston 31 is freely slidable in cylinder 30. Piston 31 may be caused to reciprocate rapidly within cylinder 30, preferably at between 4,000 and 8,000 cycles per minute, by air fed through hose 32. At an intermediate part of the string 14, a core ejection passage leads from the bore of the inner tube, to curve out through a side of the body, being connected to a core ejection hose 33 leading to an inspection trough (not shown). Hose 33 is curved as shown with a large radius of curvature so as not to strain sections of core during their passage.

Connectors of any suitable type are provided whereby additional lengths of double tubes 17, 18 may be connected in the drill string as may from time to time be required.

In use, the drilling unit is lowered on cable

The drilling rig is mounted on a barge or platform 10, to which a tower 11 is attached at 12. The tower 11 supports, via turntable 13, a drill string 14 which drives a bit 15 drilling at the earth's surface or sea-bed 16.

The drill string 14 has an outer tube 17 and an inner tube 18, both of mild steel. The inner tube 18 is disposed co-axially within and is spaced from the outer tube 17, so that there is an annular space 19 between the two. At their upper ends, the two tubes are welded or otherwise secured together at 20.

The outer tube 17 extends downwardly for a somewhat greater distance than the inner tube 18, and this lower part of tube 17 is tapped at 21 for engagement by a cutting bit or tip 15. Tip 15 is made of any suitable material of high abrasion resisting qualities. Its upper part is externally threaded for engagement in the lower part of the outer tube at 21, and therebelow it is somewhat tapered downwardly to its lower end 22, where it is sharply tapered, the whole being axially apertured. The bore of the cutting bit 15 is about equal to the bore of the inner tube 18 except at its upper end where it is enlarged in diameter to receive closely the lower end of the inner tube 18. The annular upper surface 23 of the cutting bit 15, then, closes the bottom of the annular space 19 between the outer and inner tubes; and from this annular surface 23 a number of small-diameter passages 24 lead downwardly, and then upwardly and inwardly at an angle to the axis of the cutting bit, and constitute jet nozzles. Alternatively, the jet nozzles may be machined in the lower part of the inner tube 18, again being directed upwardly and inwardly external grooves 3[illegible] on the threaded upper part of bit 35, [illegible] and inward passages 36.

The internal walls 3[illegible] of bit 35 are tapered slightly outwards so that a core passing upwards has more clearance. A ring 38 is secured around the bit and a series of radial holes 39 pass through the bit below ring 38. As the bit descends, ring 38 clears a space of slightly greater diameter than tube 19, thus preventing frictional binding of the drill string.

Spoil loosened by ring 38 passes through holes 39 and is flushed to the surface by jets 36. It is found in some types of earth drilling, to be an advantage to be able to turn the drill string to prevent sticking. Small vanes 40 may be provided on the bit to act as cutters on turning.

It is found that the core, under the influence of the jets, tends to come up in short lengths. Sometimes the core hose may choke (e.g. by reason of a stone jamming sideways). It is an advantage in this case to divert the high-pressure water and/or air to the exit of the core hose to clear the obstruction.

It will be found that the high frequency vibration of the unit will very greatly facilitate the drilling of holes, and also the removal of the unit when drilling has been completed.

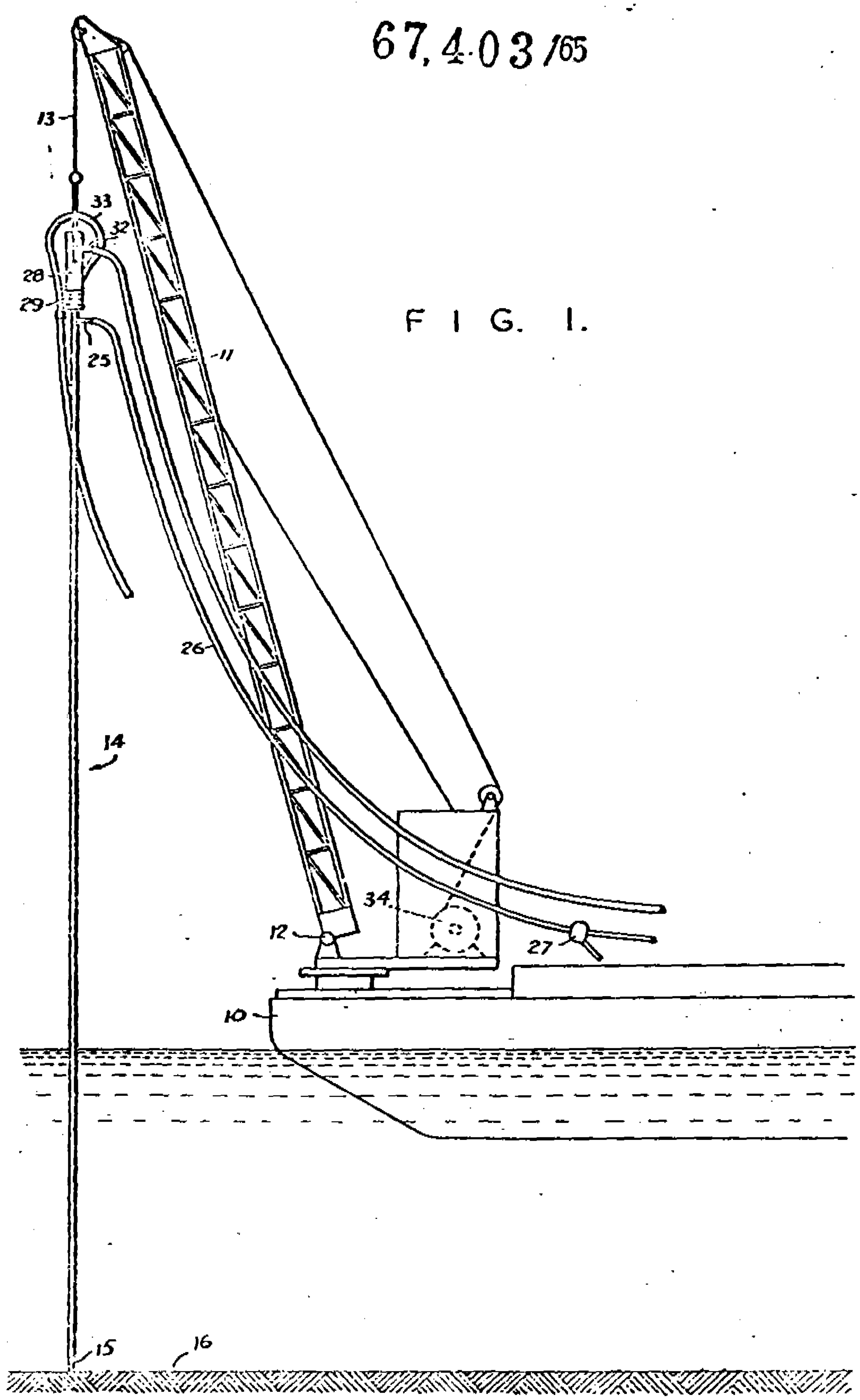
It will be understood, of course, that vibrators of types other than that described may be used, and that the particular embodiments of the invention described may be subject to many other minor modification of constructional detail and design, without departing from the scope of the invention herein claimed.

13 made fast to an eye at the top of the unit, and leading down from tower 11, the cable being controlled by a winch 34 on platform or barge 10. The vibrator 20 is operated as described, the consequent high frequency vibrations being transmitted through the string 14 to the cutting tip, and greatly facilitates the penetration of the cutting tip 15, as it is lowered on the cable. As the drilling unit descends, a core of material is cut and passes into the inner tube 18. This core may be ejected by directing air, or water, or a mixture of both, by way of mixing valve 27 through hose 26 and inlet 25 to annular space 19 and thence through the jets 24 at the lower end of inner tube 18. The descent of the drilling unit may be interrupted at intervals, at which times the cores within the unit are propelled up through the inner tube 18 and the core ejection passage 33 to the inspection trough; or the drilling, and the passage of the core up through the unit may be substantially continuous.

Whether air alone, or water alone, or a mixture of both, should be used in the ejection of the core will depend largely on the nature of the material being drilled.

In the modified bit shown in FIG. 3, the general arrangement of tubes 17, 18 is similar to that in FIG. 2. However, the jet passages are formed by axial

67,403/65



F I G. 1.

408715

408715

The claims defining the invention are as follows:-

1. An earth drilling unit for producing a core of drilled earth, including a first tube, a second tube mounted coaxially within said first tube and sealed thereto to form an annular space able to be pressurized, an annular cutting bit attached to the lower end of said first tube, a vibrator attached to the upper part of said first tube to impart to said tube and said bit a vibration substantially in the direction of the longitudinal axis of said tubes, means for directing fluid under pressure into said annular space, and jet passages for said fluid passing from said annular space into the interior of said second tube. (2nd December, 1965)

2. A unit as claimed in claim 1, in which said jet passages extend upwardly and inwardly through said bit or through said second tube. (2nd December, 1965)

3. A unit as claimed in claim 1 or 2, in which said bit is screw-connected to said first tube and the upper annular surface of said bit closes the lower end of said annular space. (2nd December, 1965)

4. A unit as claimed in any prior claim in which said bit includes an outer peripheral ring and a series of radial holes below said ring. (2nd December, 1965)

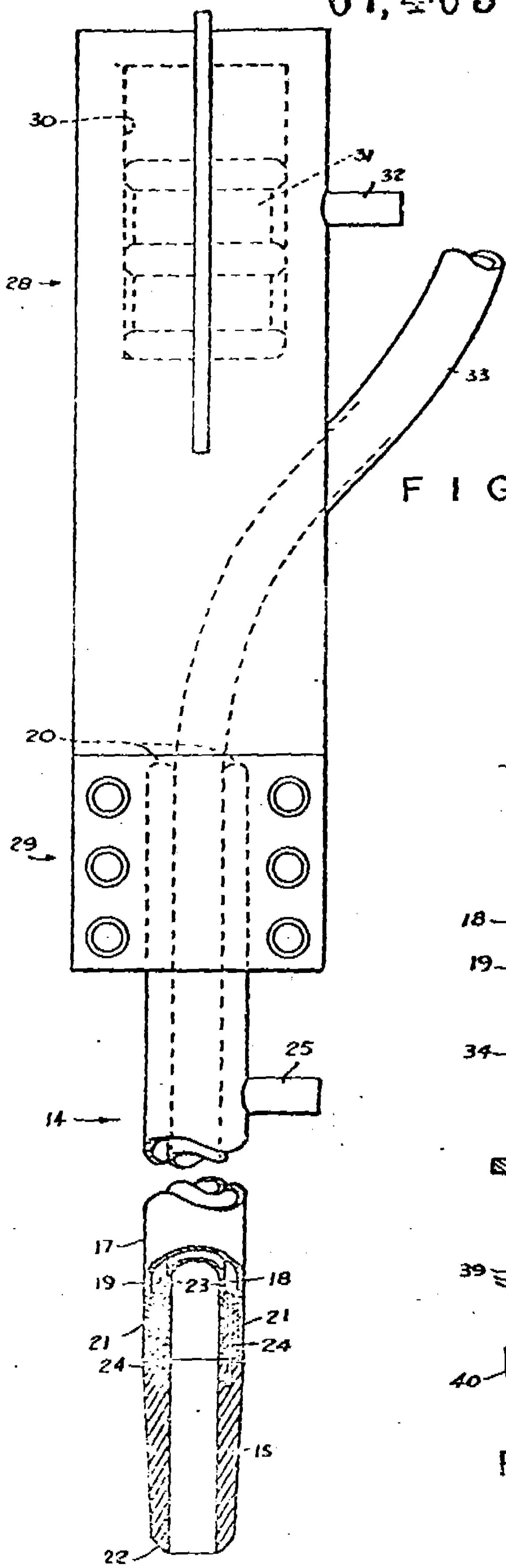
5. A unit as claimed in claim 4, in which the central bore of said bit widens towards its top. (2nd December, 1965)

6. An earth drilling unit substantially as described with reference to FIG. 1 and FIG. 2 or FIG. 1 and FIG. 3 of the accompanying drawings. (2nd December, 1965)

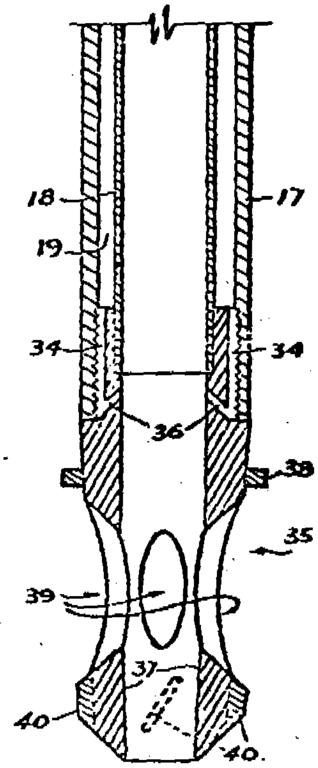
DATED this Thirtieth day of November, 1966.

ERIC CLIFFORD BRAUMANN,
FREDERICK WILLIAM REICHELT, and
CHARLES BRUCE HOPE.
By their Patent Attorneys,
G.R. CULLEN & COMPANY.

67,403/65



F I G. 2.



F I G. 3.

408715

FILE 2 1978.

MINING DRILL.

NOW 48720/79.

Commonwealth of Australia

IN THE MATTER of the Patents Act, 1952

and

IN THE MATTER of an Application No. PD.5150
for Letters Patent by

ERIC CLIFFORD BRAUMANN

Complete Specification

"DRILLING APPARATUS AND METHOD"

G. R. Cullen & Company
Patent & Trade Mark Attorneys

Colonial Mutual Building,
289 Queen Street, Brisbane, Queensland,
Australia. 4000
Telephone 21 8761

COMMONWEALTH OF AUSTRALIA

The Patents Act 1952-1969

Name of Applicant: BRAUMANN, Eric Clifford

Address of Applicant: Cunningham Avenue, The Spit, Gold Coast, Queensland, 4215 Australia.

Actual Inventor: BRAUMANN, Eric Clifford

Address for Service: G.R. CULLEN & COMPANY, Patent & Trade Mark Attorneys, 280 Queen Street, Brisbane, in the State of Queensland, Commonwealth of Australia.

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"DRILLING APPARATUS AND METHOD"

The following statement is a full description of the invention including the best method of performing it known to us:

THIS INVENTION relates to drilling apparatus and in particular drilling apparatus for the mining of underground material such as gold and other valuable minerals, and coal.

Hitherto gold in relatively deep locations or leads is found in an alluvial layer overlying bedrock and sometimes beneath a basalt cap. The bedrock often comprises consolidated kaolin or clay.

The main difficulty in mining such a formation is the presence of large amounts of water in the alluvial. It is not possible to use the usual shaft methods in many cases.

An object of the invention is to provide a method and apparatus for unmanned mining of such formations.

Accordingly, the invention in one aspect, comprises drilling apparatus for drilling a substrate having an alluvial deposit including:

a drill tube including an outer tube component and an inner tube component thereby forming a space therebetween;

operating means for operating the drill tube so as to penetrate the substrate;

means for lowering and raising the drill tube;

drilling means associated with a lower end of the drill tube including one or more drilling jets which are in fluid communication with said space;

said drilling means also including one or more lift yets which are also in fluid communication with said space;

fluid means associated with said space for delivering fluid under pressure to the or each drilling jet and the or each lift jet;

said drill tube being rotatable relative to the substrate, the construction and arrangement being such that the drill tube penetrates the substrate under the influence of the operating means until the drilling means reaches the alluvial deep lead wherein the or each drilling jet is actuated and alluvium is brought to the surface of the substrate under the action of the or each lift jet, up the bore of the inner tube component.

The drill tube is suitably elongate and preferably includes an outer tube component, an intermediate tube component and an inner tube component. The drill tube is desirably of constant cross section. The drill tube may also include a plurality of drill tube sections which are releasably secured to each other. This may ensure that the drill tube can be utilized for varying depths of the bore.

The drill tube may have operating means for operating the drill tube and this may comprise means associated with the upper end of the drill tube for vibrating the tube so as to penetrate the material being drilled. In one form a high frequency vibrator may be mounted fixedly to the upper end of the drill tube. The vibrator may be of any suitable type. Preferably the vibrator includes a vibrator housing which desirably has a lower portion which is in the form of a clamp and clamped to the upper end of the drill tube. The upper portion of the housing may consist of or include a cylinder which is co-axial with the drill tube. A piston may be freely slidable within the cylinder.

The piston may be caused to reciprocate rapidly within the cylinder preferably at between 4,000 and 8,000 cycles per minute. To accomplish this, air may be fed into the cylinder via a plurality of access ports located in the side wall of the cylinder by an air hose which is attached at one end to the cylinder. The other end of the air hose may be connected to a convenient source of pressurized air such as an air compressor.

Reference is now made to a preferred embodiment of the invention as shown in the accompanying drawings wherein:

FIG. 1 shows a schematic view of the drilling apparatus;

FIG. 2 shows a detailed sectional view of the drilling jets and lift jets associated with the drilling means; and

FIG. 3 shows a plan view of the apparatus shown in FIG. 2.

In the drawings, the drilling apparatus includes drill tube 10 having an outer tube component 11, intermediate tube component 12 and inner tube component 13. The annular spacing between components 11 and 12 is designated 14, the annular spacing between components 12 and 13 is designated 15, and the bore of the inner tube component is designated 16.

The drill tube 10 may have a drill bit or drilling member 17 which is desirably releasably attached to the drill tube 10 at its lower end thereof. The drill bit 17 is open ended and is desirably tubular having a continuous side wall bounding an interior chamber.

The drill bit 17 may have an upper portion 18 which has a constant circular transverse cross section and a lower portion 19 which side wall converges inwardly toward the longitudinal axis of the drill tube 10. At the upper end of the drilling member the interior chamber may communicate with the annular spacings 14 and 15 as well as the bore 16 of the inner tube component 13. As shown in FIG. 2, drill bit 17 has an annular spacing or passage 20 which communicates with spacing 14.

The drilling jet 21 may be of any appropriate form. In the most preferred form they are located at spaced intervals around the side wall of the drill bit 17 and located in the upper portion thereof. Each of the drilling jets preferably project outwardly from the side wall of the drill bit 17.

It is also preferred that they are oriented so that their respective longitudinal axes are angled with a slight upward tilt relative to the horizontal. Most preferably there is provided three drilling jets 21 at intervals of 120° around the side wall of the drilling member.

The free ends of each drilling jet 21 may include a nozzle or other suitable head member having an exit orifice of restricted diameter relative to the bore of each nozzle so as to cause water passing through each jet to be emitted therefrom under pressure.

In this form of the invention each drilling jet 21 may be connected to a source of pressurized water or other suitable fluid. In one form this may include a high pressure water pump 22 which has a water hose 23 connecting with the annular spacing 14. There also may be a control valve (not shown) associated with the water hose. At the lower end of the drill tube the annular spacing 14 communicates with the interior chamber of the drill bit 17 via passage 20 to convey pressurized water from the water pump 22 to each drilling jet 21.

The drilling apparatus of the invention may also include a plurality of lift jets 24 which are associated with the drill tube 10 (more preferably the lower end thereof) and cause material being drilled to pass upwardly through the bottom open end of the drill tube 10 by creating a pressure differential or "venturi" effect, between the exterior and interior of the drill tube.

In an even more preferred arrangement, each lift jet 24 may be located in drill bit 17 at or adjacent to the bore 16 of the inner tube component 13 of the drill tube 10 and is oriented so that their respective longitudinal axes project upwardly toward the axis of the inner tube component 13. Suitably each lift jet 24 may point at a near vertical angle and be attached to the internal surface of the upper portion 18 of the drill bit 17. The lower portion 19 of the drilling member by having an inwardly converging internal surface may facilitate the venturi effect of the lift jets 24 in causing the desired upward movement of the material being drilled.

In this form of the invention the lift jets 24 may have the same construction ... the drilling jets and communicate with the passage 20 which communicates with annular spacing 14. At the upper end of the drill tube 10 this annular spacing 14 may communicate or be connected with one end of a supply hose 25 connected at its other end to water pump 26 which is connected to supply tank 27.

At the upper end of the drill tube there also may be located a transport conduit for transporting drilled material compressor 18 through variable pressure valve 26 which may vary the amplitude of the vibrations. Compressor 18 has an air filter and air intake line 26.

The vacuum line 16 from vibrator 14 includes a first water trap 35 before connecting with vacuum gauge 25 on control panel 19 for measuring the amount of pressure in drilling tube 10. Vacuum line 16 also connects with progressive valve 21 on control panel 19 which increases the vacuum in tube 10 after it has penetrated seabed 22. Vacuum line 16 then passes through a second water trap 32 having water drain off 33 before connecting with vacuum pump 17 which has air exhaust 34 to atmosphere.

There is also shown water input line 29 having a water intake 37 which connects with water pump 28. The output line 30 from pump 28 has a water jet valve 31 for lubricating the exterior surface of tube 11 before application of PVC core collection tube 11.

The drilling tube 10 may also have associated therewith support means. In a particularly preferred arrangement the drill tube may be supported by a cable 37 which depends from the mast 38 of barge 20. Suitably elevation and lowering of the cable 37 may be actuated by an air winch 39 located on the deck of the barge on the other side of the mast 38 to the drilling apparatus. The cable 37 may be retained on the mast by pulleys (not shown) to facilitate movement of the cable 37 relative to the mast 38.

There also may be attached or adjacent to the upper end of the drilling tube 10 a guard member 40 which prevents the drilling apparatus from bumping into barge 20. The vibrator 14 may also have exhaust line 36.

The drilling operation may also be facilitated by lowering the assembly of drill tube and vibrator through an access opening (not shown) located in the deck of the barge 20 by actuating the winch 39 controlling movement of the cable 37 supporting the tube 10 and vibrator 14.

The drill tube may also have associated therewith a support stand to support the tube in uneven sea beds. In one form the stand may comprise a central tube and a plurality of legs (e.g. three) attached at their upper ends respectively to the central tube. At the location of attachment to the central tube each leg may be pivotally attached to a collar which is slidably engaged by an associated bearing means (e.g. a nylon bush) to the central tube. The interior of the collar may form a cylinder which is movable along the central tube by air pressure generated from the air compressor on the deck of the barge. Suitably the cylinder is connected by an air hose to the compressor.

The support stand may also include a buoyancy member attached to the upper end of the central tube. The vibrator which is located adjacent the upper end of the drill tube is suitably located within the bore of the central tube and may run in a track associated with the interior side wall of the central tube so that the assembly of vibrator and drill tube may move upwardly or downwardly along the bore of the central tube. There may be provided a stop member at the bottom end of the tube to prevent movement of the vibrator beyond this point.

During operation of the support stand it is lowered over the side of the barge and supported in the water by the buoyancy member. The collar may then be activated so that it slides downwardly along the central tube so as to result in outward movement of each leg to support the stand. As the drilling operation commences the vibrator begins to move downwardly along the bore of the central tube and may be retained in any desired position by suitable control of the air hose associated with the vibrator. When the vibrator reaches the stop member the drilling operation is finished and the legs retracted from their outward position to lie in their normal non-operative attitude adjacent the central tube. The collection tube 11 with its core sample may then be removed from the drill tube in the manner described previously.

However, it must be emphasized that in most cases the support stand can be dispensed with and the only support needed for the drill tube is the cable described previously.

From the foregoing description it will be appreciated that the drilling apparatus of the invention is exceedingly simple in construction when compared to more elaborate conventional drilling apparatus (e.g. conventional drilling rigs using expensive drilling bits) but is just as effective in operation.

Also by the use of the invention more accuracy in coring is obtained than was heretofore possible. The need for more accuracy in coring is now required by most Government departments and mining companies as well as consulting engineers carrying out feasibility studies on sea bed excavation. The invention enables the obtaining of cores of unconsolidated material and the use of the PVC collection tube enables the core samples to be stored indefinitely and also is adapted for convenient transportation. By the use of the invention, cores have been recovered in water depths of 30 metres under varying sea conditions. Ten metre cores have been recovered in sizes from 25 mm. to 50 mm. diameter. By the use of variable diameter couplings 42 drill tubes of various diameters can be utilized. Preferably all components are made from stainless steel.

During the method of the invention, as soon as tube 11 strikes substrate 22 a small vacuum is applied which is gradually increased by appropriate adjustment of valve 21 as tube 11 is lowered into substrate 22 by winch 39. This enables the obtaining of a core which is representative of the stratification of substrate 22. The vibrator 14 by vibrating tube 10 penetrates into substrate 22.

When the desired depth is reached the tube 10 may be removed from substrate 22 by actuation of winch 39 with the vacuum being held at an appropriate value (e.g. the maximum value obtained when the desired height is reached) to retain the core inside tube 10.

A water jet from water line 30 may be applied to the exterior surface of tube 10 before collection tube 11 is applied to the open bottom end thereof from a roll of clear plastic film. When the vacuum is released the core will slowly out of the PVC tube pulling the tube downwardly from tube 10. If the core is still firmly retained in tube 10, a few vibrations from vibrator 15 may loosen it. If it resists ejection a jet of water or air may be applied from the top of the core from the upper end of tube 10.

Once the PVC core sample is obtained, information as to the bore number and water depth may be written on it before the core is transported to the laboratory for testing.

By the practice of the present invention, deep leads bearing gold, tin or other vauiable mineral and varying from 80 to over 500 feet may be mined successfully. Also damage to crop overlays or existing vegetation are minimal if the deep leads are in a cultivated area. Thus no open cuts are necessary and mining companies can operate without fear of offending conservationists or property owners such as farmers.

The claims defining the invention are as follows:-

1. Drilling apparatus for drilling a substrate having an alluvial deposit including:

a drill tube including an outer tube component and an inner tube component thereby forming a space therebetween;

operating means for operating the drill tube so as to penetrate the substrate;

means for lowering and raising the drill tube;

drilling means associated with a lower end of the drill tube including one or more drilling jets which are in fluid communication with said space;

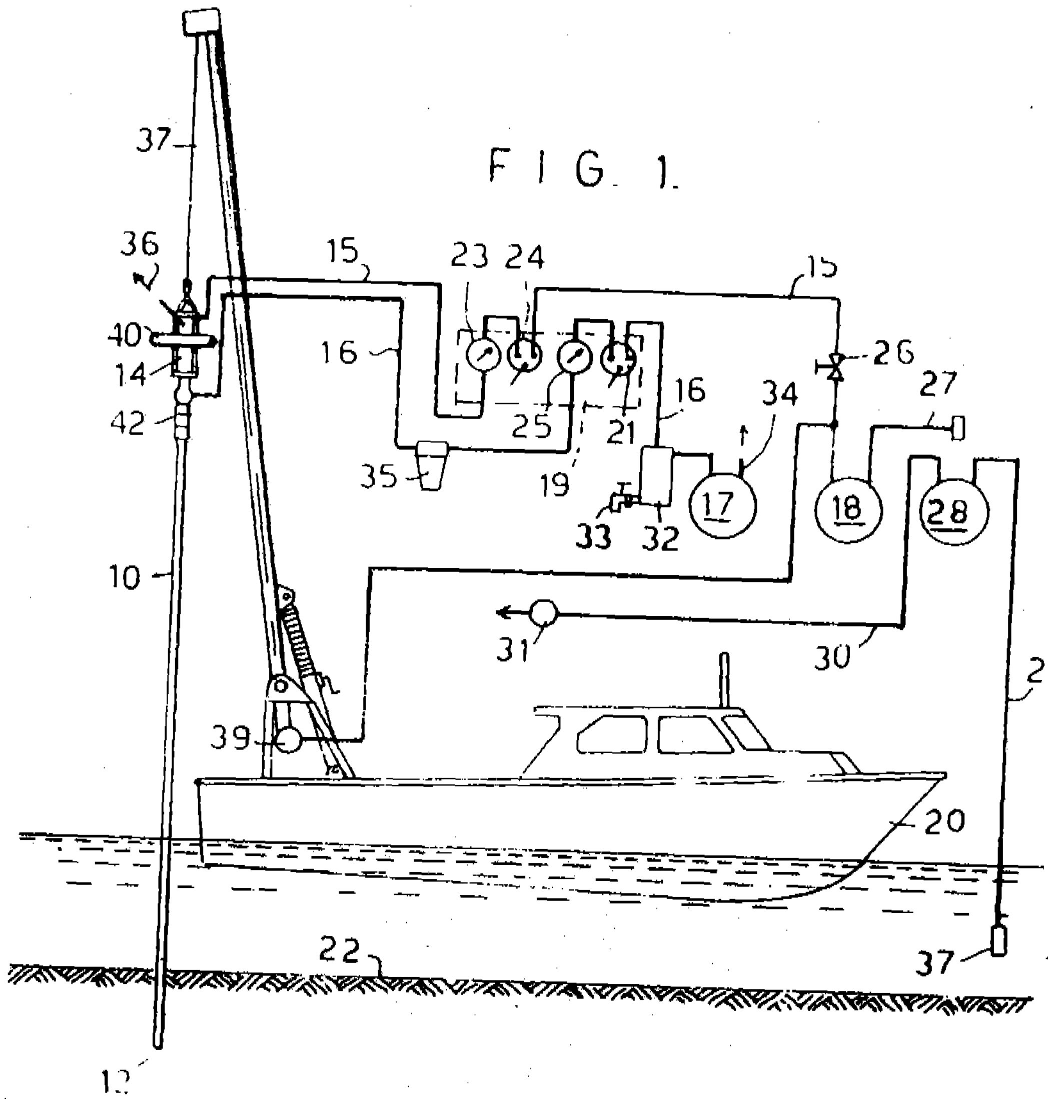
said drilling means also including one or more lift jets which are also in fluid communication with said space;

fluid means associated with said space for delivering fluid under pressure to the or each drilling jet and the or each lift jet;

said drill tube being rotatable relative to the substrate the construction and arrangement being such that the drill tube penetrates the substrate under the influence of the operating means until the drilling means reaches the alluvial deep lead wherein the or each drilling jet is actuated and alluvium is brought to the surface of the substrate under the action of the or each lift jet up the bore of the inner tube component.

2. Drilling apparatus as claimed in claim 1 wherein said drill tube further includes an intermediate tube component located between the outer tube component and the inner tube component thus forming an outer space between the outer and intermediate component and an inner space between the intermediate and inner component which each surround the bore of the inner tube component, each of said inner and outer spaces being associated with fluid means for delivering fluid under pressure, the or each lift jet and the or each drilling jet being in communication with said outer space, said drilling means also

FIG. 1.


37
36
15
23 24
15
40
14
16
26
27
34
16
42
25
21
35
19
17
18
28
33 32
10
31
30
29
39
20
22
37
12

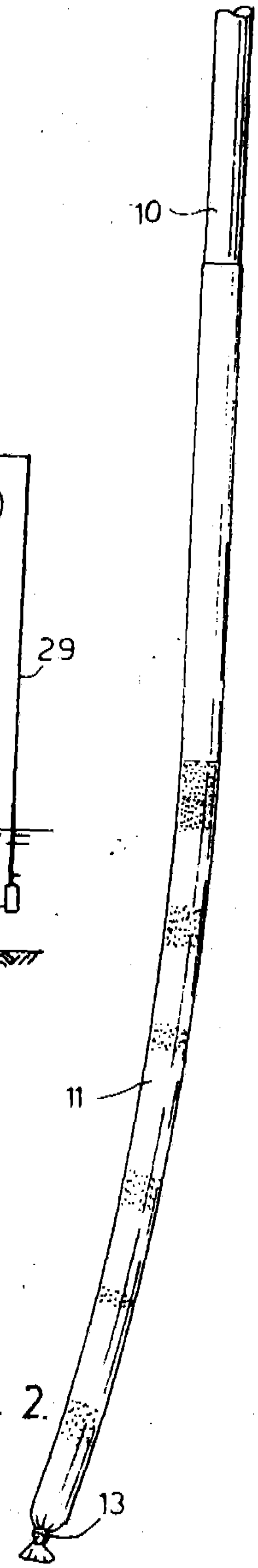
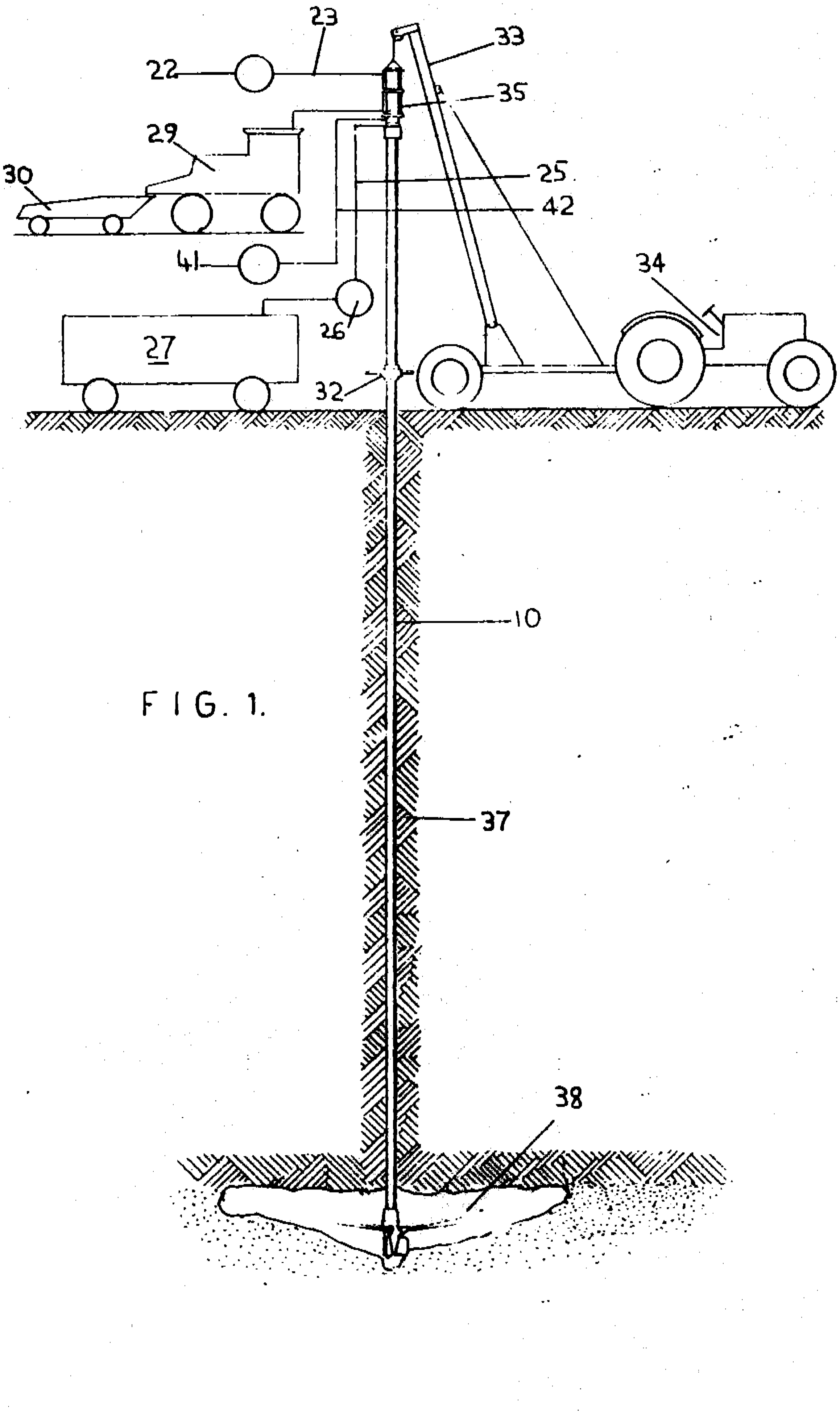
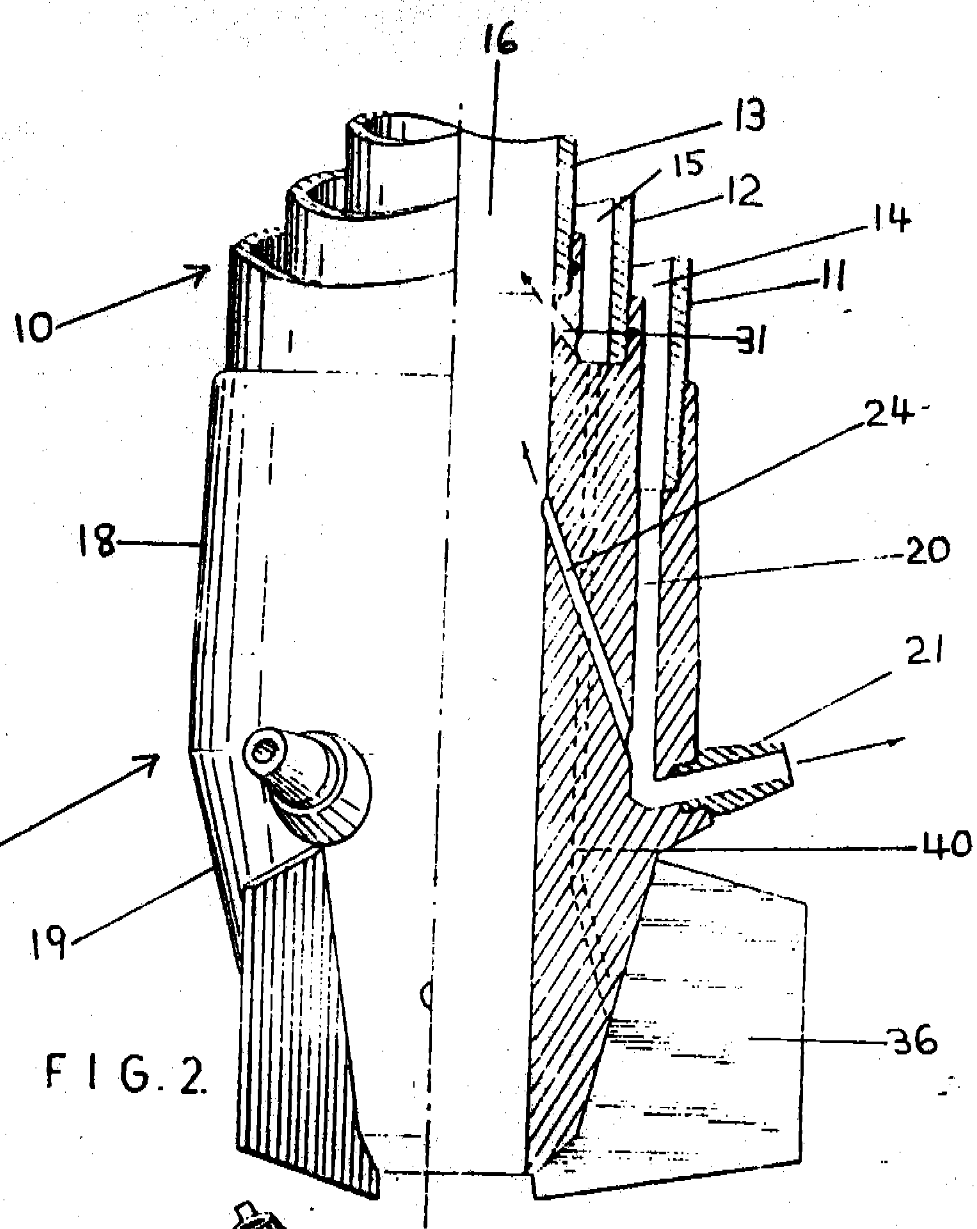
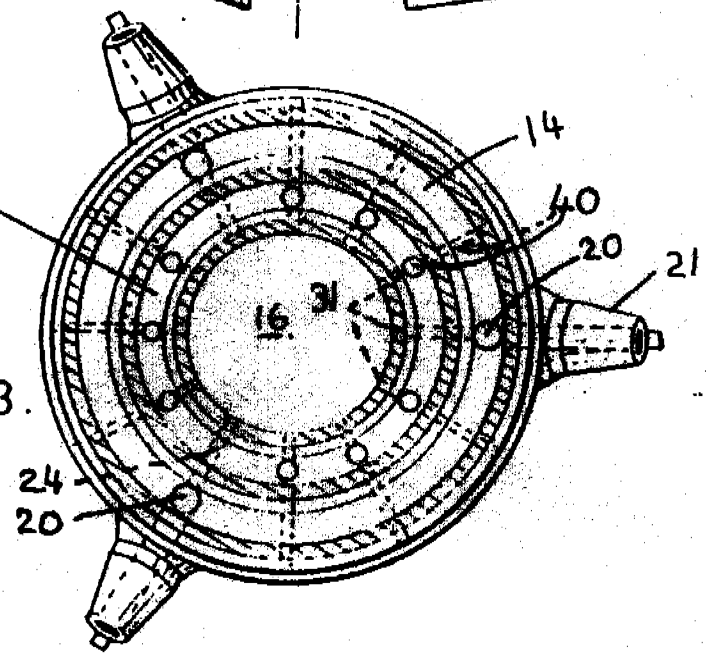

10
11
13

FIG. 2.



F I G. 1.


16
13
15
12
14
11
10
31
24
18
20
21
17
40
19
36
F I G. 2.


14
15
40
20
21
16
31
24
20
F I G. 3.

SEA PROBE 12 JUNE 78

COMMONWEALTH OF AUSTRALIA

18133/79.

IN THE MATTER of the Patents Act, 1952

and

IN THE MATTER of an Application No. PD 4754
for Letters Patent by

Applicant: ERIC CLIFFORD BRAUMANN

Number:

Date:

Title: "DRILLING METHOD AND APPARATUS"

COMPLETE SPECIFICATION

G. R. CULLEN & COMPANY
Patent and Trade Mark Attorneys
Colonial Mutual Building
289 QUEEN ST. BRISBANE
QUEENSLAND 4000

COMMONWEALTH OF AUSTRALIA

The Patents Act 1952-19

Name of Applicant: ERIC CLIFFORD BRAUMANN

Address of Applicant: Cunningham Avenue, The Spit, Gold Coast, Queensland.

Actual Inventor: ERIC CLIFFORD BRAUMANN

Address for Service: G.R. CULLEN & COMPANY, Patent & Trade Mark Attorneys, 289 Queen Street, Brisbane, in the State of Queensland, Commonwealth of Australia.

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"DRILLING METHOD AND APPARATUS"

The following statement is a full description of the invention including the best method of performing it known to us:

THIS INVENTION relates to a method of drilling and which is particularly adapted to soft drilling through earth, gravel, sand, clay and soft stone such as shale or sandstone. The invention also relates to drilling apparatus for use in the method.

Hitherto such drilling apparatus has been somewhat complex in construction and accordingly rather expensive.

Accordingly it is an object of the invention to provide drilling apparatus which is simple in construction and efficient in use.

The drilling apparatus of the invention facilitates drilling operations and can be used in a number of different applications. For example, it can be used for the purpose of forming a shot hole such as may be required for seismic surveys, or for the purpose of procuring for analysis samples of material at selected depths below the earth's surface or the seabed.

However, the drilling apparatus of the invention has been found to be particularly efficacious in coring the seabed for evaluation of stratas or change of stratas for stratographic purposes. The drilling apparatus can also be utilized to evaluate mineral, sand, gravel and aggregate deposits.

According to the invention there is provided a method of drilling including the steps of:

(i) drilling a substrate with a drill tube;

(ii) producing a pressure differential between the interior and exterior of the tube so as to draw material being drilled into the tube, said pressure differential being gradually increased from initial penetration into the substrate until a desired depth has been achieved wherein said pressure differential is at a maximum value;

(iii) withdrawing the drilling tube from the substrate containing a core of substrate material within the tube, wherein said core is held within the tube by said pressure differential being maintained at an appropriate value; and

(iv) relaxing said pressure differential so as to allow the core to pass out through the open bottom end of the drill tube and into a collection receptacle.

The invention also provides drilling apparatus for use in the method including a drilling tube having an open bottom end; vacuum forming means associated with the upper end of the drilling tube so as to form a pressure differential between the interior and exterior of the tube when said tube is being drilled into a substrate: said vacuum forming means including valve means so as to progressively increase the pressure differential between the interior and exterior of the drilling tube as it penetrates into the material being drilled; vibrating means associated with the upper end of the drilling tube for vibrating said drilling tube so as to penetrate the material being drilled; means for raising and lowering of the drilling tube; and core collection means for collecting a core of drilled material from within the drilling tube after it is removed from said substrate.

Reference is now made to the drawings which relate to a preferred embodiment of the invention, wherein:

FIG. 1 is a schematic view of the drilling apparatus of the invention; and

FIG. 2 is a detailed view of a preferred form of core collection means.

In the drawings, the drilling tube 10 is an elongate member of desirably constant cross section. At the drilling end of the tube there may be provided a plurality of drilling projections (e.g. two or three) which extend from the peripheral edge of the tube to facilitate penetration into the material being drilled. However this is not essential. If desired a drilling bit may be inserted into the drill tube and attached thereto but in practice it has been found that this is not necessary and can be dispensed with. The drill tube 10 has a bottom open end 12.

Preferably the drilling tube 10 may have associated therewith core collection means which can collect sample cores of material being drilled. In one form this may comprise a collection tube 11 of tubular configuration of complementary shape to the drill tube and which can fit either inside or outside the drill tube. When fitted either inside or outside the drill tube there may be provided a securing collar or other appropriate securing means located upwardly of the bottom drill tube which secures the collection tube to the drill tube. The collection tube 11 is open at its upper end and sealed at its bottom end 13 as shown in FIG. 2 in any appropriate manner. Preferably however when applied to the exterior surface of the drilling tube the collection tube 11 (desirably made from flexible material such as clear PVC) does not require any securing means.

In another form of core collection means there may be provided a core ejection passage located in an intermediate part of the drilling tube which is connected to a core ejection hose leading to an inspection trough. However the first described form of core collection means using the core collection tube is preferred.

If desired, the drilling tube 10 may comprise a plurality of drill tube components with each component being releasably secured to each other. This may ensure that the drilling tube can be utilized for varying depths of the seabed so as to sample different cores which are characteristic of stratas located at particular depths of the seabed.

The drilling tube 10 has operating means for operating the drilling tube and this may comprise means associated with the upper end of the drilling tube for vibrating the tube so as to penetrate the material being drilled. In one form a high frequency vibrator 14 may be mounted fixedly to the upper of the drilling tube 10. The vibrator may be of any suitable type. Preferably the vibrator includes a vibrator housing which desirably has a lower portion which is in the form of a clamp and clamped to the upper end of the drilling tube. The upper portion of the housing may have formed therein a cylinder which is co-axial with the drill tube. A piston may be freely slidable within the cylinder. The piston may be caused to reciprocate rapidly within the cylinder preferably at between 4,000 and 8,000 cycles per minute. To accomplish this, air may be fed into the cylinder via a plurality of access ports (not shown) located in the side wall of the cylinder by an air hose 15 which is attached to the cylinder.

When the vibrator 14 is located above sea level the pressure of the vibrator will be at atmospheric level. However if it is desired to submerge the vibrator 14 it may have a shroud placed over it which has an open ended tube associated therewith which extends beyond the sea level. This places the vibrator in its submerged position at atmospheric pressure.

The drilling apparatus of the invention also includes means for creating a pressure differential between the interior and exterior of the drilling tube 10 so as to draw material being drilled into and up the drilling tube 10. In one form this may comprise a vacuum hose 16 connected to the upper end of the drill tube adjacent to and below the aforementioned vibrator 14. The vacuum hose 16 may be attached to any convenient vacuum source such as a vacuum pump 17. The vacuum pump 17 may be of the Rootes type but is more preferably a vane type rotary vacuum pump which is driven by an appropriate drive motor. The vacuum pump may also be coupled to an air compressor 18 and control panel 19 located on the deck of a barge 20 carrying the drilling tube 10.

The vacuum pump 17 may also have associated therewith a manually adjustable vacuum increasing valve 21 so as to increase the pressure differential between the interior and exterior of the drilling tube 10 as it progressively penetrates deeper and deeper into the substrate material 22 being drilled.

As shown in FIG. 1, the air line 15 for vibrator 14 connects with control panel 19 through air pressure gauge 23 and on-off switch 24. The air line 15 then communicates with air after passage through the drill tube 10 to a treatment plant wherein the drilled material is subsequently treated to extract the mineral contained therein. The treatment plant may comprise primary separator 29 and secondary separator 30.

There also may be provided at spaced intervals along the length of the drill tube auxiliary lift jets 31 which assist in causing the upward movement of the drilled material along the bore of the drill tube 10 by increasing the pressure differential which exists between the interior and exterior of the drill tube. Suitably these auxiliary lift jets 31 are located adjacent to the inner tube component 13 and oriented in the same manner as the lift jets 24. Suitably each auxiliary lift jet 31 may be located at the junction of adjacent drill tube sections (not shown).

If desired, there may be provided a multiplicity of upwardly directed fine holes (not shown) in the side wall of the inner tube to further assist the function of the lift jets.

The drill tube may also be rotatable relative to the bore when the drilling jets are in operation and this may be accomplished by the use of a "Kelly" attached to the upper end of the drill tube. Alternatively, the drill tube 10 may be manually rotated by grasping collar 32. The drill tube is also movable in an up or down direction relative to the bore and this may be accomplished by supporting the upper end of the drill tube by a winch 33 or other appropriate means mounted on truck 34.

In operation of a preferred embodiment of the drilling apparatus of the invention the drill tube 10 comprising the inner tube component 13, intermediate tube component 12 and outer tube component 11 is lowered by the winch 33 with the lift jets 24 being actuated so as to cause material being drilled to be passed upwardly through the bore of the inner tube and passed to the treatment plant. The vibrator 35 mounted atop the drill tube 10 vibrates the drill bit 17 to facilitate penetration into the material. Cutting members 36 attached to drill bit 17 assist in the initial drilling of substrate 37 (e.g. bedrock) being drilled.

When the drill tube reaches a desired depth (e.g. where gold bearing material is located) the drilling jets 21 may then be actuated by the control valve so as to clear an area while the drill tube is rotated a full 360° with the gold bearing material being passed up the drill tube by the action of the lift jets 24. The drill tube 10 may be slowly rotated back and forth to provide full circle mining. Owing to the desired slight upward angle of the drilling jets, the bottom of the drilled area 38 slopes downwardly towards the drill tube 10 so that loose material is carried toward the open bottom of the drill bit 17.

In very wet ground it may be necessary to pump the water out from auxiliary bores surrounding the drill tube so that the drilling jets will not be flooded.

Thus it will also be appreciated that the invention includes a method of drilling a substrate having an alluvial deposit including the steps of:

(i) drilling through the substrate with a drilling tube;

(ii) upon reaching the level of alluvial deposit, actuating one or more drilling jets wherein fluid at high pressure is sprayed on said alluvial deposit; and

(iii) causing a pressure differential between the exterior and interior of the drilling tube so as to cause alluvial material to be brought to the surface of the substrate along the bore of the drill tube.

In operation of the method of the invention the drill tube 10 may be used to initially drill into a substrate until a water table is reached. The water can then be pumped to the surface as drilling proceeds downwardly. The water may be stored for later use if required.

The mined material from the substrate passing through separators 20 and 30 (or just separator 29) may be stacked on the ground for future use or sale. This material is normally sought after by local government authorities for construction of building projects, dams, roads etc.

When the drill reaches an alluvial deposit it then may be stopped and jets 21 actuated slight raising and lowering of the drill tube 10 (e.g. about 0.5 metre) facilitates extraction of mined material. Air jets 40 as shown in FIG. 2 assist in initial drilling and these may be reduced to a minimum. Lift jet 24 as well as drilling jets 21 facilitate extraction of alluvium. The wash that is cut as jets 21 cut into area 38 travel downwardly and up bore 16. The jet tube 10 may be slowly rotated back and forth over 360^{0} with each jet 21 being rotated over a 120^{0} arc. The jets 21 may develop up to 250 p.s.i. pressure. Suitably the inner tube 13 may be made from PVC. This operation continues until about 30 cubic metres of alluvium is raised to the surface. At this stage the alluvium may be assessed to ascertain that all alluvium so far extracted is of economic significance. The mineral such as gold or tin may then be evaluated as it reaches secondary separator 30. The drill tube 10 may then be raised to the surface by winch 33. A new bore may then be commenced with the original mined bore being filled with residual wash material from the new bore. The outer tube 11 is suitably formed from stainless steel.

The pump 26 is suitably such to supply a 45mm jet of water through jets 21 at 250 p.s.i. The air compressor 41 may supply air at 200-250 p.s.i at 150 cubic ft. per minute through air line 42 to spacing 15. The outer tube component 11 may transmit high frequency vibrations from vibrator 35 to drill bit 17 during drilling. A control panel (not shown) may handle all variation of air pressure and water pressure required.

At each coupling of separate drill tube sections (not shown) there may be provided O-ring seals. Suitably the drill tube 10 may comprise as many drill tube sections that are required to reach the alluvium level.

Initially when drilling is commenced the vibrator 35 is actuated and the drill tube 10 lowered by winch 35. Air may be supplied to secondary air jets 40 to assist in drilling. A controlled amount of water under pressure may also be fed to air jets 40 to provide a wetting agent for air jets 40. During initial drilling the drill tube may be turned or oscillated through 120^{o} to facilitate drilling. Then the air and water mix through jets 40 may be slowly increased in pressure as the drill tube 10 progresses downwardly. The drill cuttings may be ejected to the surface through bore 16. A small flow of water may be allowed to pass through jets 21.

When the first drill tube section is buried in the bore a second drill tube section may be coupled to the first. This is achieved by unscrewing the vibrator 35 from the first drill tube section 10 and inserting the second drill tube section. The vibrator is raised to the top of winch 33 to facilitate this. This process is repeated until the alluvium level is reached. Then the drill tube may be lowered a short distance into the bed rock material such as soft granite or clay. The vibrator 35 is allowed to continue operating when jets 21 are actuated to full capacity. The drill tube 10 is still allowed to oscillate 120^{o} or more. Preferably jets 21 are inclined upwardly about 15^{o} to the horizontal. Jets 24 speed up the movement of alluvium up bore 16 through to the top of drill tube 10 which is open where the aluvium is passed into primary separator 28.

At the open bottom of drill bit 17 the pressure is then at a very low level or vacuum such as 10-25 inches of mercury. This operation continues until all the required amount of rich alluvium is brought to the surface.

To assist recovery of wash the drill tube sections and bit 17 are raised and lowered a small distance to release any trapped particles of wash. The water jets 21 are then shut off and the complete drill tube assembly is withdrawn and set up for the next operation. Preferably the couplings between adjacent drill tube sections are ponted to enable the air jets and water jets to operate independently.

The Claims defining the invention are as follows:

1. A method of drilling including the steps of:

(i) drilling a substrate with a drill tube;

(ii) producing a pressure differential between the interior and exterior of the tube so as to draw material being drilled into the tube, said pressure differential being gradually increased from initial penetration into the substrate until a desired depth has been achieved wherein said pressure differential is at a maximum value;

(iii) withdrawing the drilling tube from the substrate containing a core of substrate material within the tube, wherein said core is held within the tube by said pressure differential being maintained at an appropriate value; and

(iv) relaxing said pressure differential so as to allow the core to pass out through the open bottom end of the drill tube and into a collection receptacle.

2. A method as claimed in Claim 1 wherein the drilling of the substrate is carried out by vibrating the drill tube so as to penetrate the substrate.

3. A method as claimed in Claim 1 or 2 wherein in step (iii) the pressure differential is maintained at the maximum value achieved in step (ii).

4. A method as claimed in any preceding claim wherein in step (iv) a collection tube is passed upwardly over the open bottom end of the drilling tube, said collection tube having a closed lower end wherein said core is passed into the collection tube after the relaxation of said pressure differential.

5. A method as claimed in Claim 4 wherein the collection tube is made from flexible material and the exterior surface of the drilling tube is lubricated before passing the collection tube upwardly over the open bottom end of the drilling tube.

6. Drilling apparatus for use in the method of any one of Claims 1 to 5 including:

a drilling tube having an open bottom end;

vacuum forming means associated with the upper end of the drilling tube so as to form a pressure differential between the interior and exterior of the tube when said tube is being drilled into a substrate: said vacuum forming means including valve means so as to progressively increase the pressure differential between the interior and exterior of the drilling tube as it penetrates into the material being drilled;

vibrating means associated with the upper end of the drilling tube so as to penetrate the material being drilled;

core collection means for collecting a core of drilled material from within the drilling tube after it is removed from said substrate.

7. Drilling apparatus as claimed in Claim 6 wherein the vacuum forming means includes:

(i) a vacuum hose attached to the upper end of the drilling tube;

(ii) a vacuum pump connected to the vacuum hose; and

(iii) a manually adjustable vacuum increasing valve associated with the vacuum pump.

8. Drilling apparatus as claimed in Claim 6 or 7 wherein the vibrating means includes a high frequency vibrator mounted fixedly to the upper end of the drilling tube.

9. Drilling apparatus as claimed in any one of Claims 6 to 8 wherein said core collection means is a collection tube made of flexible material open at its upper end which is slipped over the bottom end of the drilling tube and drawn upwardly from the bottom end of the drilling tube, said collection tube being closed at its lower end.

10. Drilling apparatus as claimed in Claim 9 wherein there is included means for lubricating the exterior surface of the drilling tube before the collection tube is applied thereto.

11. Drilling apparatus as claimed in Claim 6 substantially as herein described with reference to the accompanying drawings.

12. A method of drilling as claimed in Claim 1 substantially as herein described with reference to the accompanying drawings.

DATED this 15th day of June, 1979.

ERIC CLIFFORD BRAUMANN
By his Patent Attorneys,
G.R. CULLEN & COMPANY

including one or more auxiliary lift jets which are in communication with said inner space.

3. Drilling apparatus as claimed in claim 2 wherein the inner space is connected to means for delivering air under pressure to the or each auxiliary lift jet and said outer space is connected to means for delivering water under pressure to the or each lift jet and the or each drilling jet.

4. Drilling apparatus as claimed in any preceding claim wherein said drilling means includes a drill bit releasably attached to said drill tube, said drill bit being open ended and having a bore which is co-axial with the bore of the inner tube component and also including fluid passage(s) which are in fluid communication with the or each lift jet and the or each drilling jet and the space(s) in the drill tube.

5. Drilling apparatus as claimed in claim 4 wherein there is provided a plurality of drilling jets at spaced intervals about the side wall of the drill bit with each drilling jet being upwardly inclined to the horizontal.

6. Drilling apparatus as claimed in claim 4 or 5 wherein there is provided a plurality of lift jets which each extend upwardly from an associated fluid passage in said drill bit so as to be in fluid communication with the bore of the inner tube component.

7. Drilling apparatus as claimed in claim 6 wherein there are provided a plurality of said auxiliary lift jets in an upper portion of the drill bit above the plurality of lift jets, each auxiliary lift jet extending upwardly from the inner space to the bore of the inner tube component.

8. Drilling apparatus as claimed in any one of claims 4 to 7 wherein said drill bit includes a plurality of outwardly projecting drilling blades attached to the exterior surface thereof.

9. Drilling apparatus as claimed in any preceding claim wherein said operating means includes a high frequency vibrator mounted fixedly to the upper end of the drill tube.

10. Drilling apparatus as claimed in any preceding claim wherein said drill tube comprises a plurality of interconnecting drill tube sections which are releasably secured to each other so as to ensure utilization of the drill tube for varying depths of the alluvial deposit in the substrate.

11. Drilling apparatus as claimed in any preceding claim wherein said drill tube is provided with a collar above the surface of the substration whereby said drill tube may be rotated manually during operation.

12. Drilling apparatus as claimed in any preceding claim wherein there are further provided in said drill bit one or more air jets which assist in initial drilling of the substrate, the or each jet being in communication with said outer space in the drill tube.

13. Drilling apparatus as claimed in claim 1 substantially as herein described with reference to the accompanying drawings.

14. A method of drilling a substrate having an alluvial deposit including the steps of:

(i) drilling through the substrate with a drilling tube;

(ii) upon reaching the level of alluvial deposit, actuating one or more drilling jets wherein fluid at high pressure is sprayed on said alluvial deposit, and

(iii) causing a pressure differential between the exterior and interior of the drilling tube so as to cause alluvial material to be brought to the surface of the substrate along the bore of the drill tube.

15. A method as claimed in claim 14 wherein the water contained in a water table associated with the alluvial deposit is pumped to the surface of the substrate prior to step (ii).

16. A method as claimed in claim 14 or 15 wherein said drill tube is rotated during step (ii).

17. A method as claimed in claim 14, 15 or 16 wherein said drill tube has one or more lift jets which direct fluid under pressure up the bore of the drill tube and thereby cause said alluvial deposit to be transported up said bore.

DATED this thirteenth day of July, 1979.

ERIC CLIFFORD BRAUMANN
By his Patent Attorneys,
G.R. CULLEN & COMPANY.

No. [illegible]8,715

COMMONWEALTH OF AUSTRALIA

LETTERS PATENT

Elizabeth the Second, by the Grace of God of the United Kingdom, Australia and Her other Realms and Territories Queen, Head of the Commonwealth, Defender of the Faith:

To all to whom these presents shall come Greeting:

WE DO, by these Letters Patent, give and grant to the persons whose names are specified hereunder Our Special Licence and the exclusive right, subject to the laws in force from time to time in Australia or a part of Australia, by themselves, their agents and licensees, at all times during the term of these Letters Patent, to make, use, exercise and vend throughout Australia the invention the title of which is specified hereunder and being the invention that is fully defined in the claim or claims of the complete specification accepted in accordance with the *Patents Act* 1952–19 69 in such manner as they think fit, so that they shall have and enjoy the whole profit and advantage accruing by reason of the invention during that term.

Names of Patentees : ERIC CLIFFORD B[illegible], [illegible] and CHARLES BRUCE HOPE,

Address of Patentees : 109 Seagull Avenue, [illegible] Beach, Gold Coast, in the State of Queensland, Commonwealth of Australia; [illegible] Road, [illegible]enowa, in the State of Queensland aforesaid and 186 Surf Parade, Surfers Paradise, in the State of Queensland, aforesaid,

Name of Actual Inventor : ERIC CLIFFORD [illegible]

Title of Invention: A new and improved drilling [illegible]

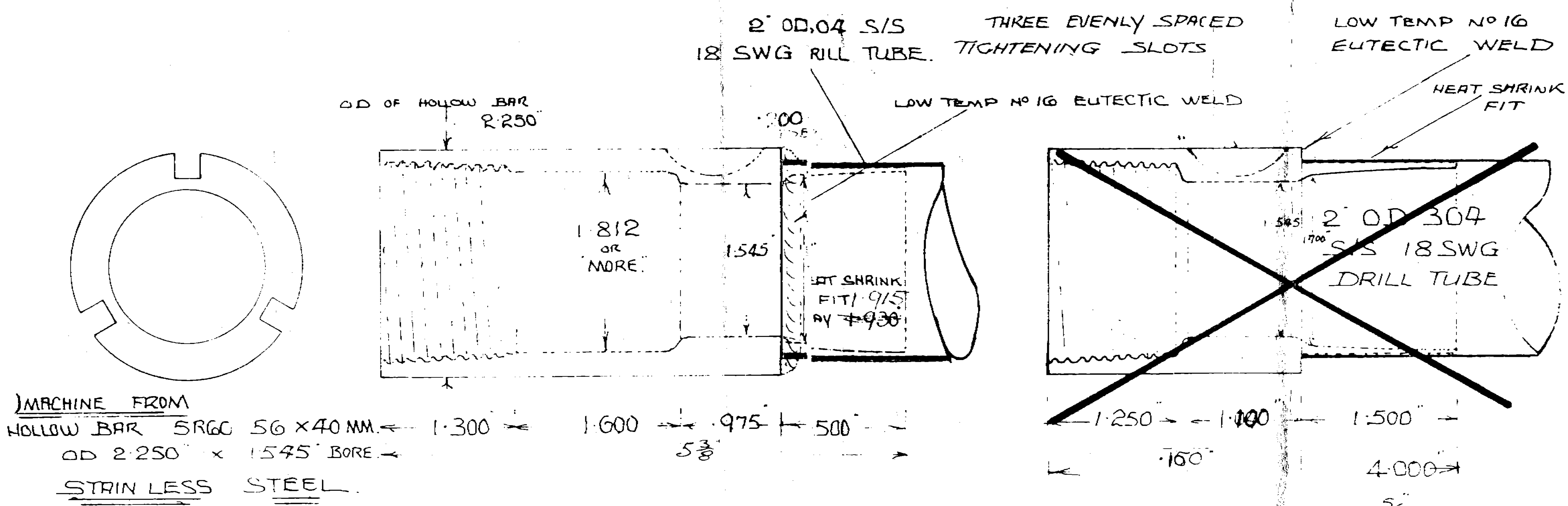
Number of Complete Specification: 408,715

Term of Letters Patent: Sixteen years commencing on 2nd December, 1966

IN WITNESS whereof Our Commissioner of Patents has caused these Our Letters Patent to be dated as of the Second day of December, One thousand nine hundred and Sixty-six, and to be sealed with the seal of the Patent Office this Fourth day of May, One thousand nine hundred and Seventy-one

K. B. PETERSSON,
Commissioner of Patents

SHEET 2. OFFSHORE DRILLERS FL APRIL 1979 ERIC BAUMANN.



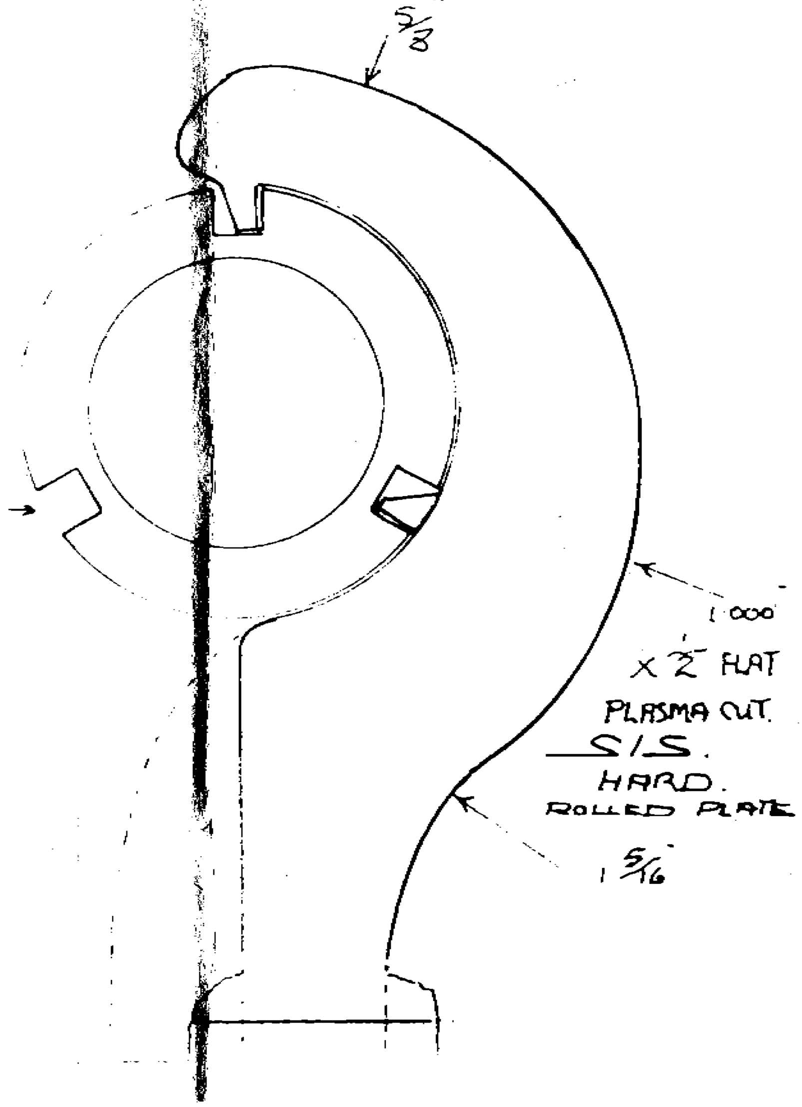
IMPERIAL WIRE GAGES

6	·192
8	·160
10	·128
12	·104
14	·080
16	·064
18	·048
20	·036
22	·028

50 MM - 2" - MULTI-PURPOSE S.P.T. DRILL TUBE ENDS

ALSO

DRILL ROD TIGHTENING WRENCH



SCALE FULL

APRIL 1973.
LE DOUBLE

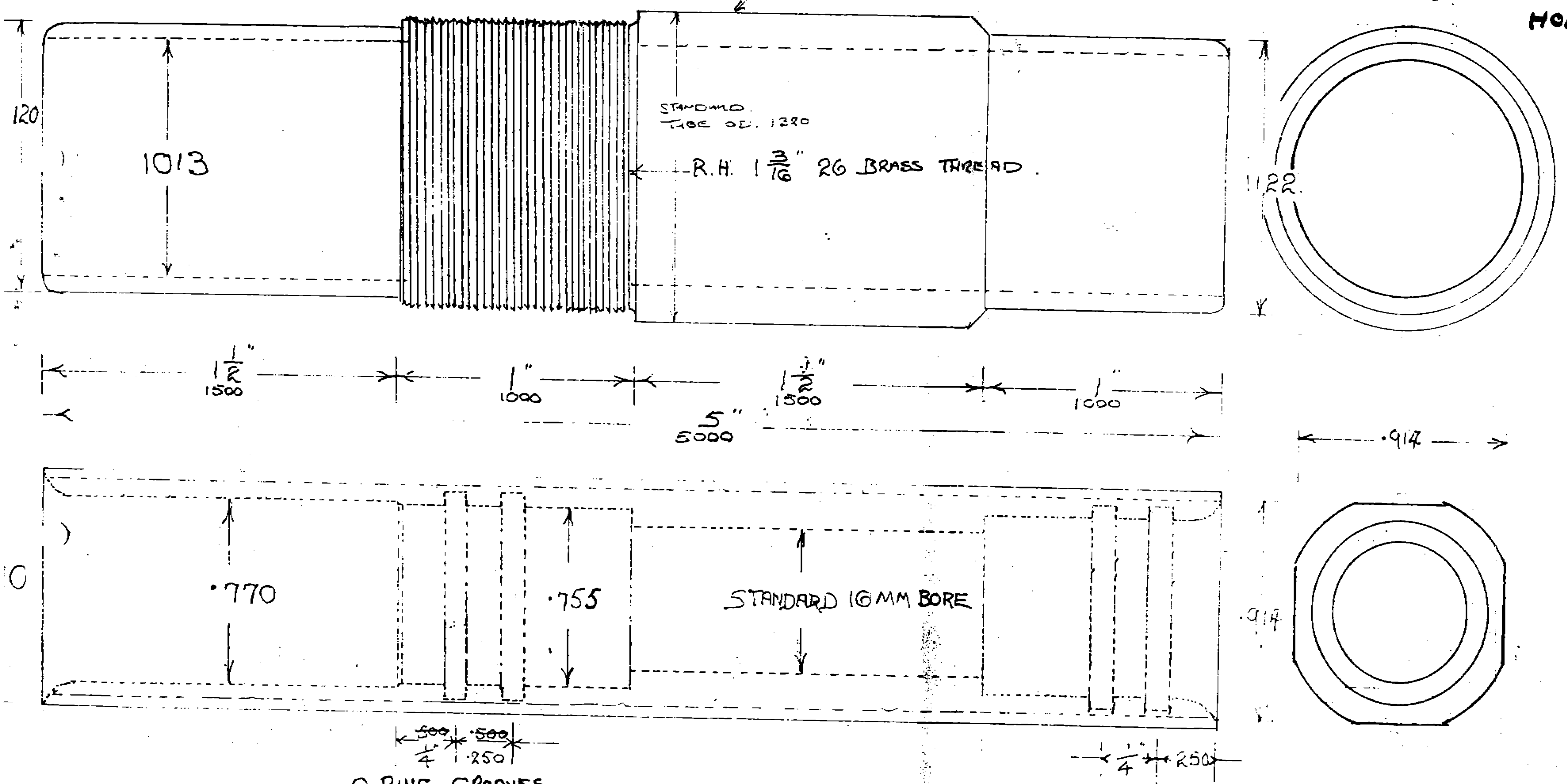
OFFSHORE DRILLERS P/L
1¼" DRILL ROD CONNECTORS.
IMPROVED FROM AUGUST 1972
DRAWING.

MACHINE FROM "SANDVIK"
1" NB S/S 316 SCH80
1320 OD
·965 I.D

5 R 60

NOMINAL BORE

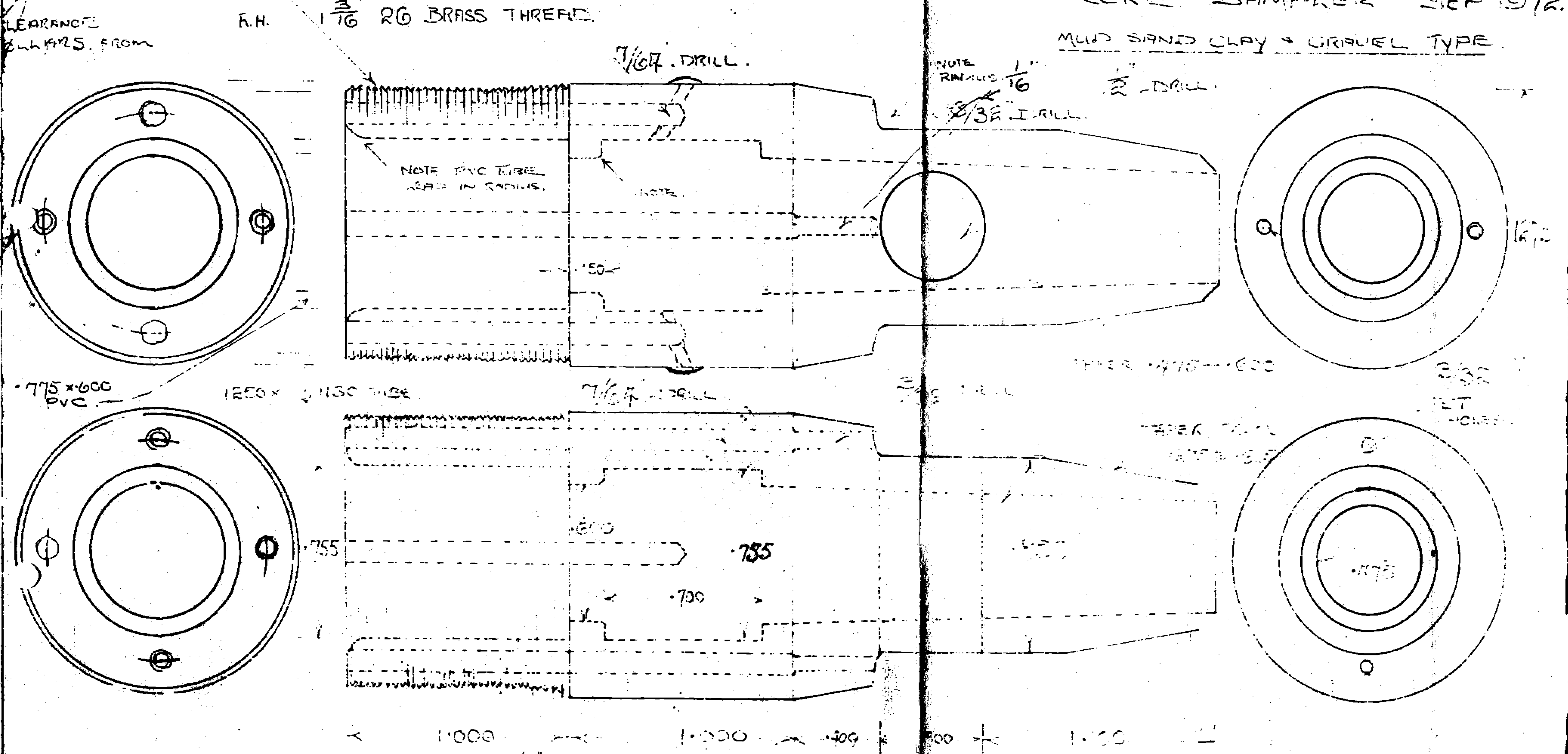
32 x 16 mm
5R60.
HOLLOW



O RING GROOVES.
·100 x 880 DEEP

AUSTRALIAN PATENT Nº 408/715. TRIPLE PURPOSE DRILL BIT. 1¼" "BRAUMANN" OCEAN BED CORE SAMPLER SEP 1972.

MUD SAND CLAY & GRAVEL TYPE



MACHINE FROM — 1½" S/S 316 BAR

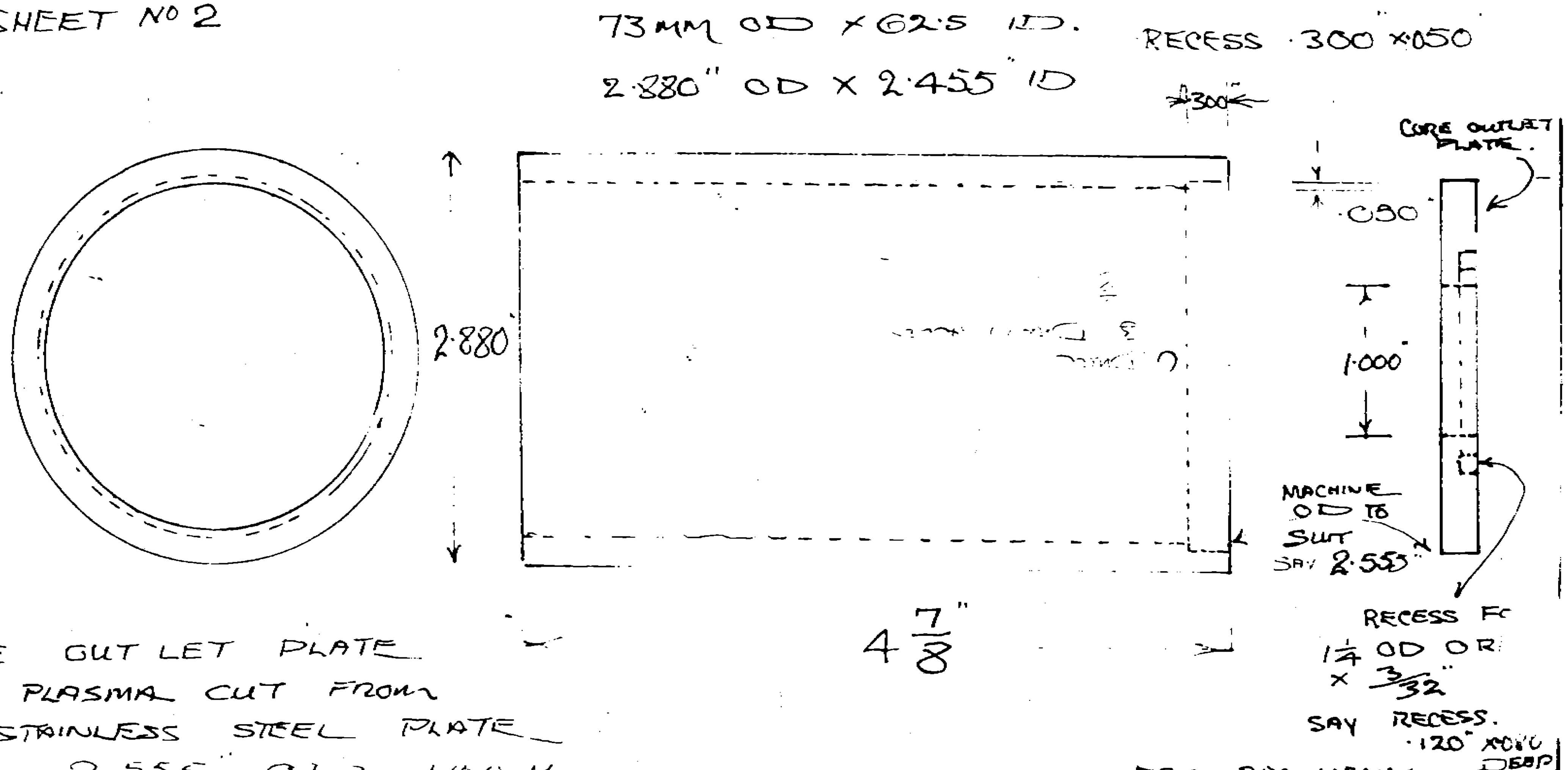
SCALE DOUBLE

USING .775 PVC CLASS "B" INNER. & 1¼" ... .600 x .665 ... DRILL TUBE S/S. E.C.H. ... 1973

OFFSHORE DRILLING P/L.
SPT MULTI-PURPOSE & SEP PROBE.
VIBRATOR SPACER.
FROM S/S TUBE.

ANNEXE SHEET NO 2

73 MM OD × 62.5 ID.
2.880" OD X 2.455" ID



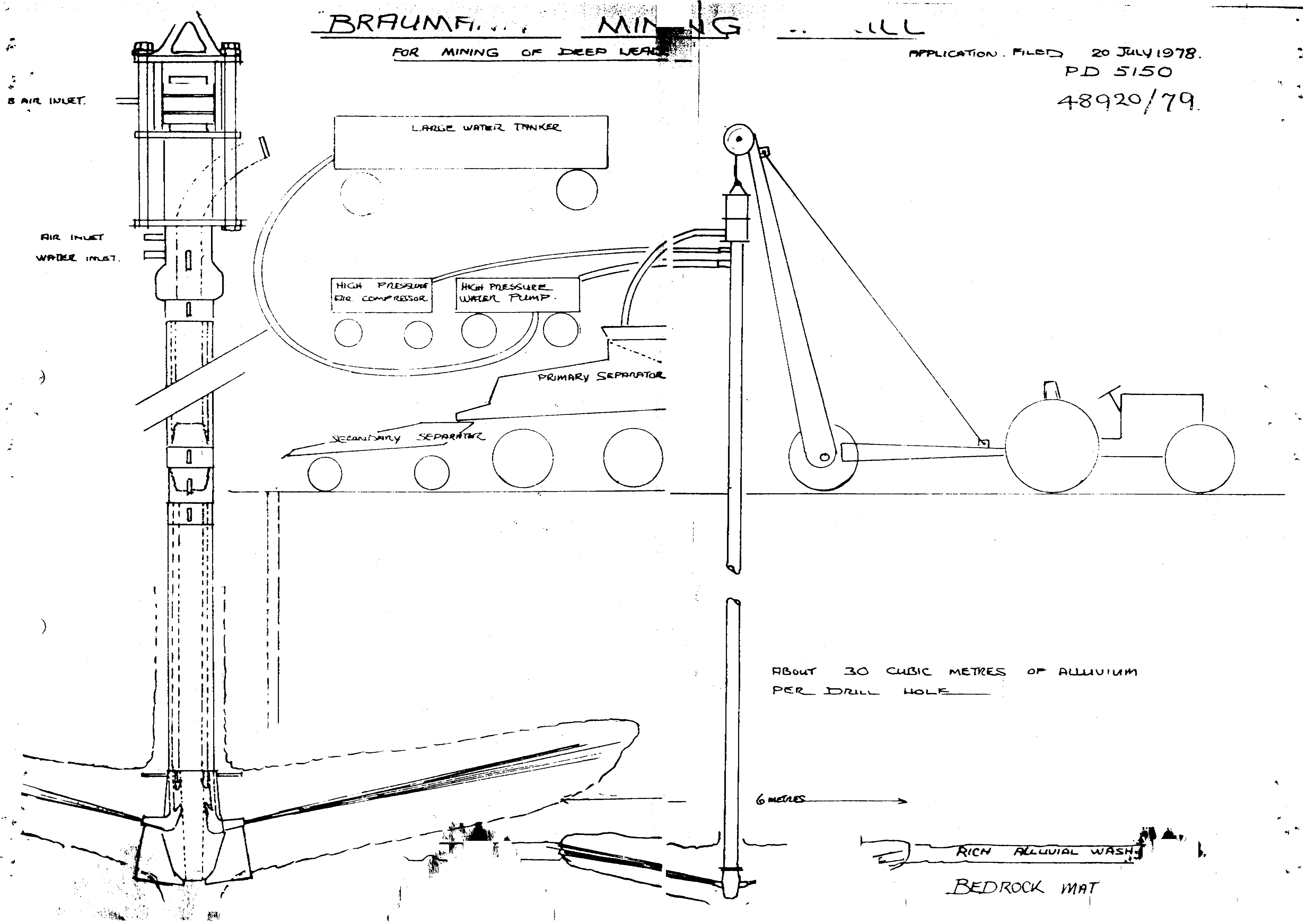
CORE OUTLET PLATE
TO BE PLASMA CUT FROM
HARD STAINLESS STEEL PLATE
OF 1/4". 2.555" O.D. ...

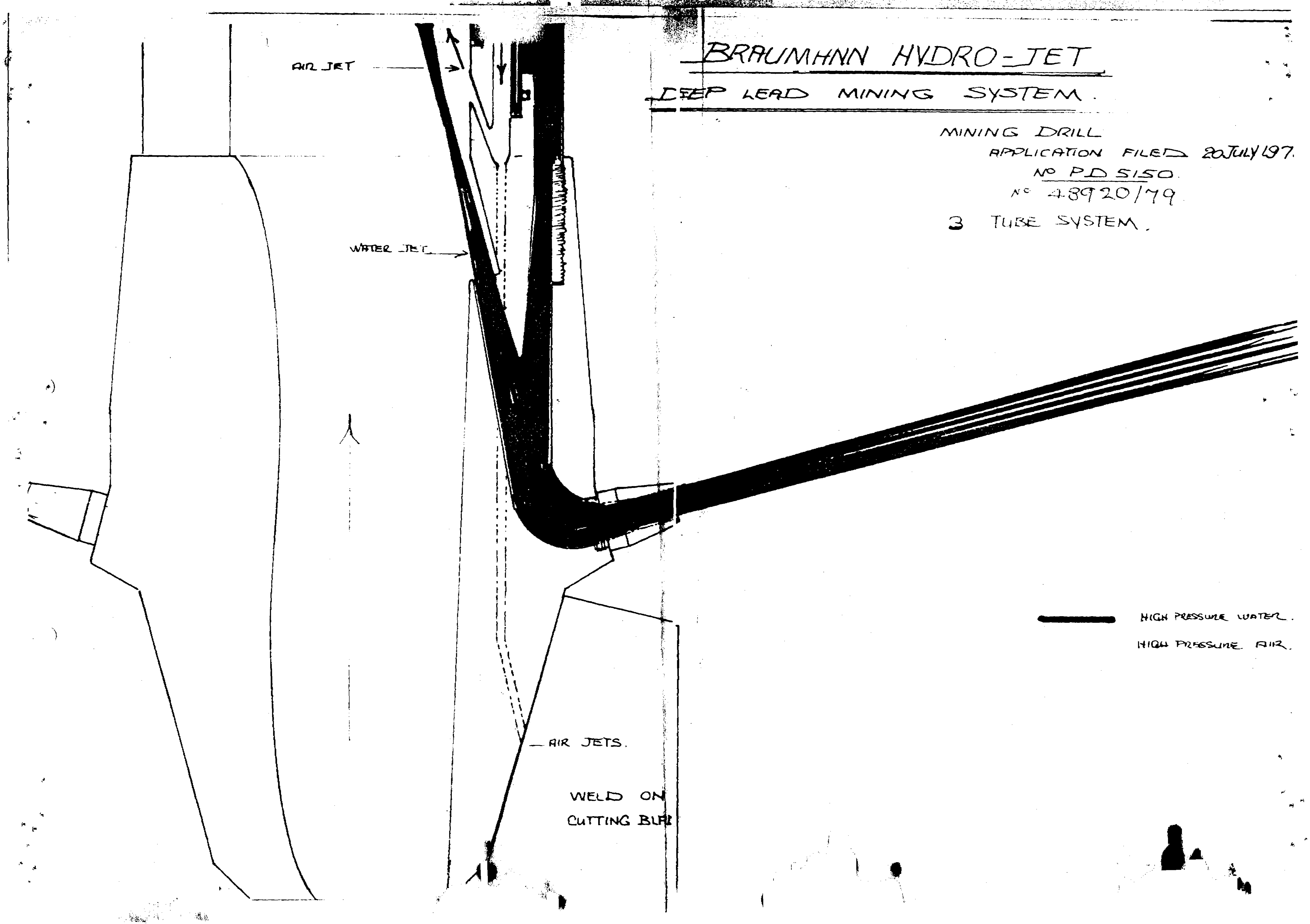
ERIC BRAUMANN
APRIL 1979

BRAUMF... MIN[illegible]G .. ILL

FOR MINING OF DEEP LEA[illegible]

APPLICATION. FILED 20 JULY 1978.
PD 5150
48920/79.





BRAUMANN HYDRO-JET
DEEP LEAD MINING SYSTEM.
MINING DRILL
APPLICATION FILED 20 JULY 197.
No P.D 5150.
No 48920/79.
3 TUBE SYSTEM.
AIR JET
WATER JET
AIR JETS.
WELD ON
CUTTING BLA
HIGH PRESSURE WATER.
HIGH PRESSURE AIR.

"BRAUMANN" SEA BED PROBE

SEA PROBE

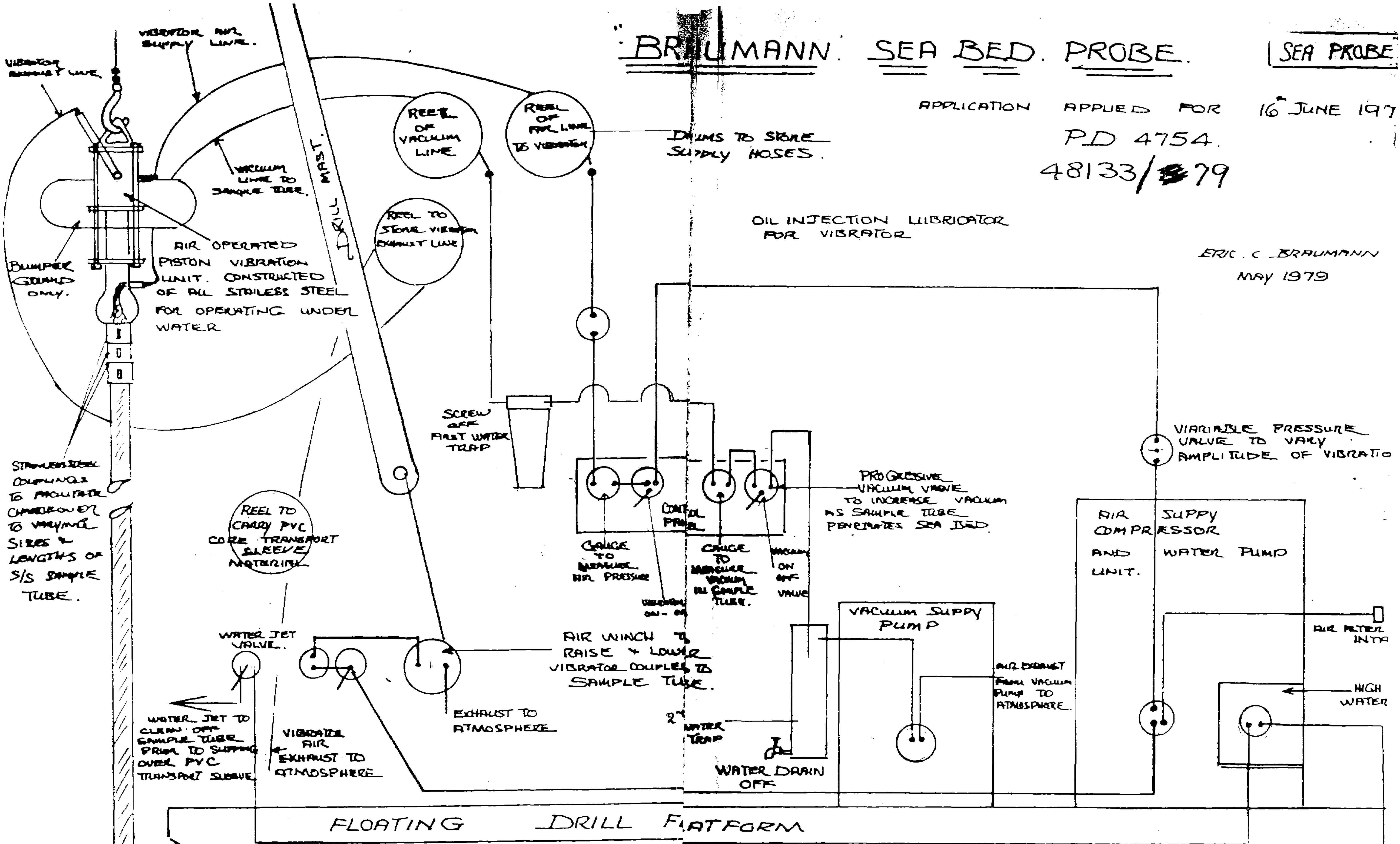
APPLICATION APPLIED FOR 16th JUNE 197[illegible]

PD 4754.

48133/79

ERIC C. BRAUMANN

MAY 1979



NOTE. WHEN DRILL SAMPLE TUBE IS LOWERED & JUST PENETRATES SEA BED A SMALL AMOUNT OF VACUUM IS APPLIED. THE VACUUM IS SLOWLY INCREASED AS SAMPLE TUBE PENETRATES SEA BED. FULL VACUUM IS APPLIED ONLY WHEN SAMPLE TUBE IS NEARING FULL PENETRATION.

THIS UNIT CAN ACCURATELY CORE SAMPLE THE SEA BED IN UNCONSOLIDATED MATERIALS TO A DEPTH LIMITED BY THE AVAILABLE HEIGHT OF DRILL UNIT. TO ENABLE SAMPLE TUBE TO BE RAISED VERTICALLY ABOVE [illegible] LEVEL FOR FEEDING [illegible] SAMPLE TUBE OF THE PVC CARRIER CORE MATERIAL

THE [illegible] VACUUM IS RELEASED & A SMALL AMOUNT OF VIBRATION FROM VIBRATOR ASSIST CORE TO FALL & BE [illegible] [illegible] OF PVC CORE CARRIER MATERIAL.

IF CORE IS RELUCTANT TO FALL CLEAN A SMALL PRESSURE OF AIR OR WATER CAN BE DIVERTED BACK INTO VACUUM LINE [illegible] PLACING PRESSURE ON TOP OF SAMPLE ASSIST IT OUT OF BOTTOM OF SAMPLE TUBE.

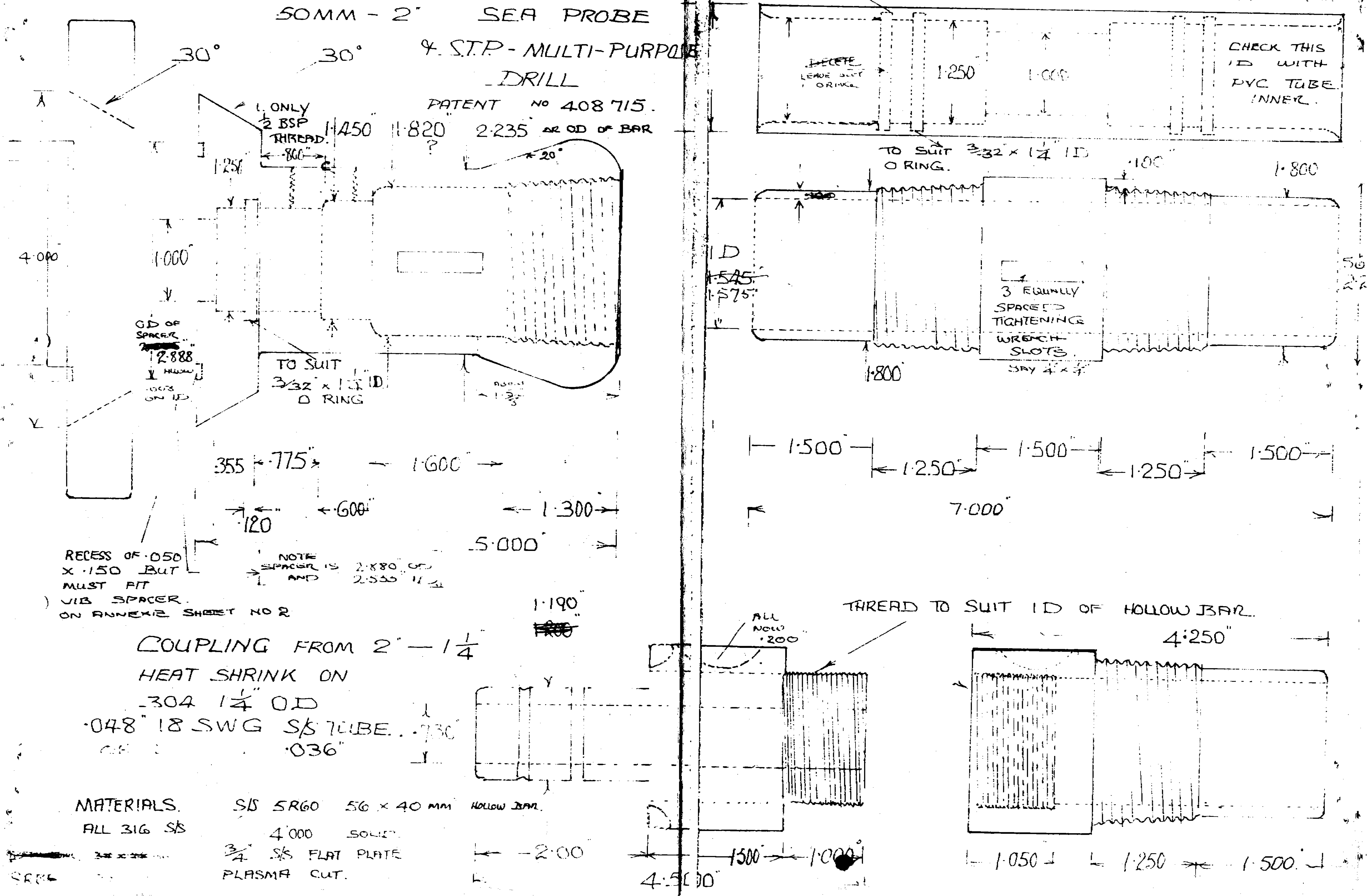
SHEET 1

OFFSHORE DRILLERS P/L

50MM - 2" SEA PROBE

& S.T.P. - MULTI-PURPOSE DRILL

PATENT No 408 715.



COUPLING FROM 2" — 1 1/4

HEAT SHRINK ON

·304 1 1/4" OD

·048" 18 SWG S/S TUBE.

·036"

MATERIALS. S/S 5R60 56 x 40 MM HOLLOW BAR.

ALL 316 S/S 4·000 SOLID

3/4" S/S FLAT PLATE

PLASMA CUT.

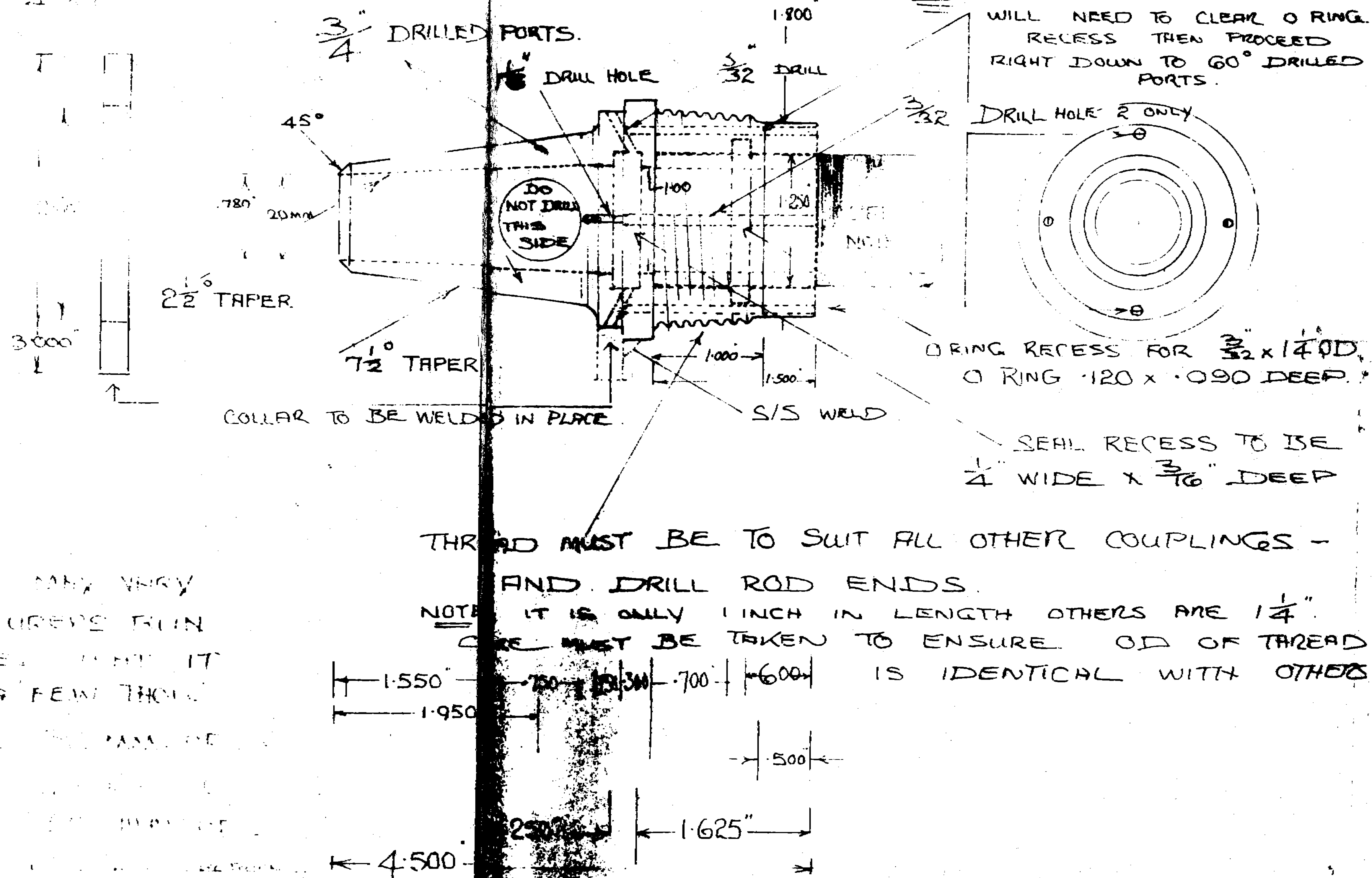
SHEET

OFFSHORE DRILLERS P/L

50 MM OR 2" SPT MULTI-PURPOSE DRILL BIT

PART OF PATENT
Nº 408 715

MACHINE FROM
$2\frac{1}{4}$" OD S/S



NOTE.

INNER PLASTIC TUBE MAY VARY ON EACH MANUFACTURERS RUN AND IS ENVISAGED THAT IT WILL VARY ONLY A FEW THOU.

$1\frac{1}{4}$" OD WILL BE [illegible]

$1\frac{1}{2}$ OD WILL BE [illegible]

2" OD WILL BE [illegible]

ACI NYLE [illegible]
GAYDOR PLASTICS [illegible]
GERARD INDUSTRIES [illegible]

SCALE. FULL

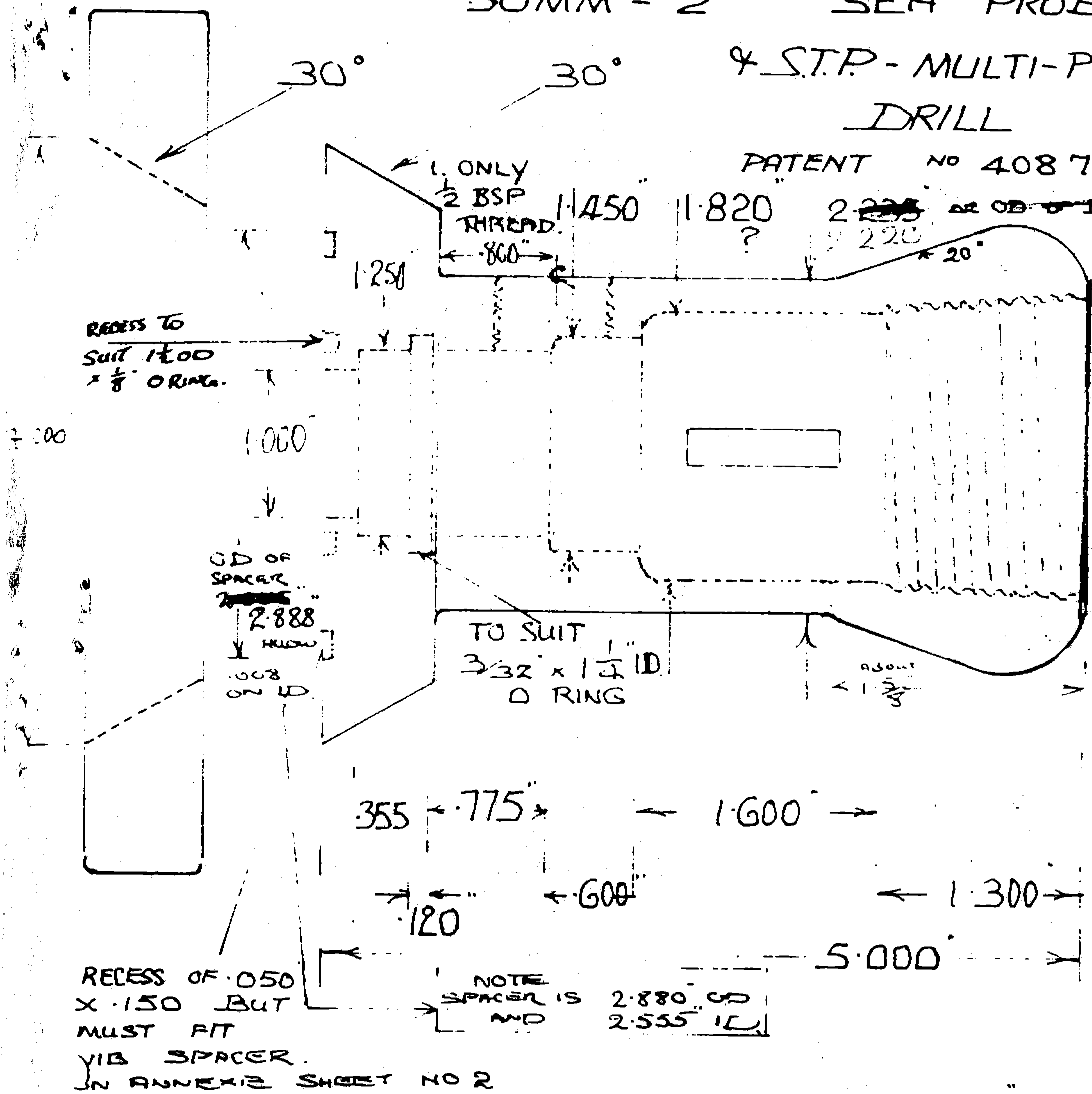
ERIC BRAUMANN
APRIL 1979

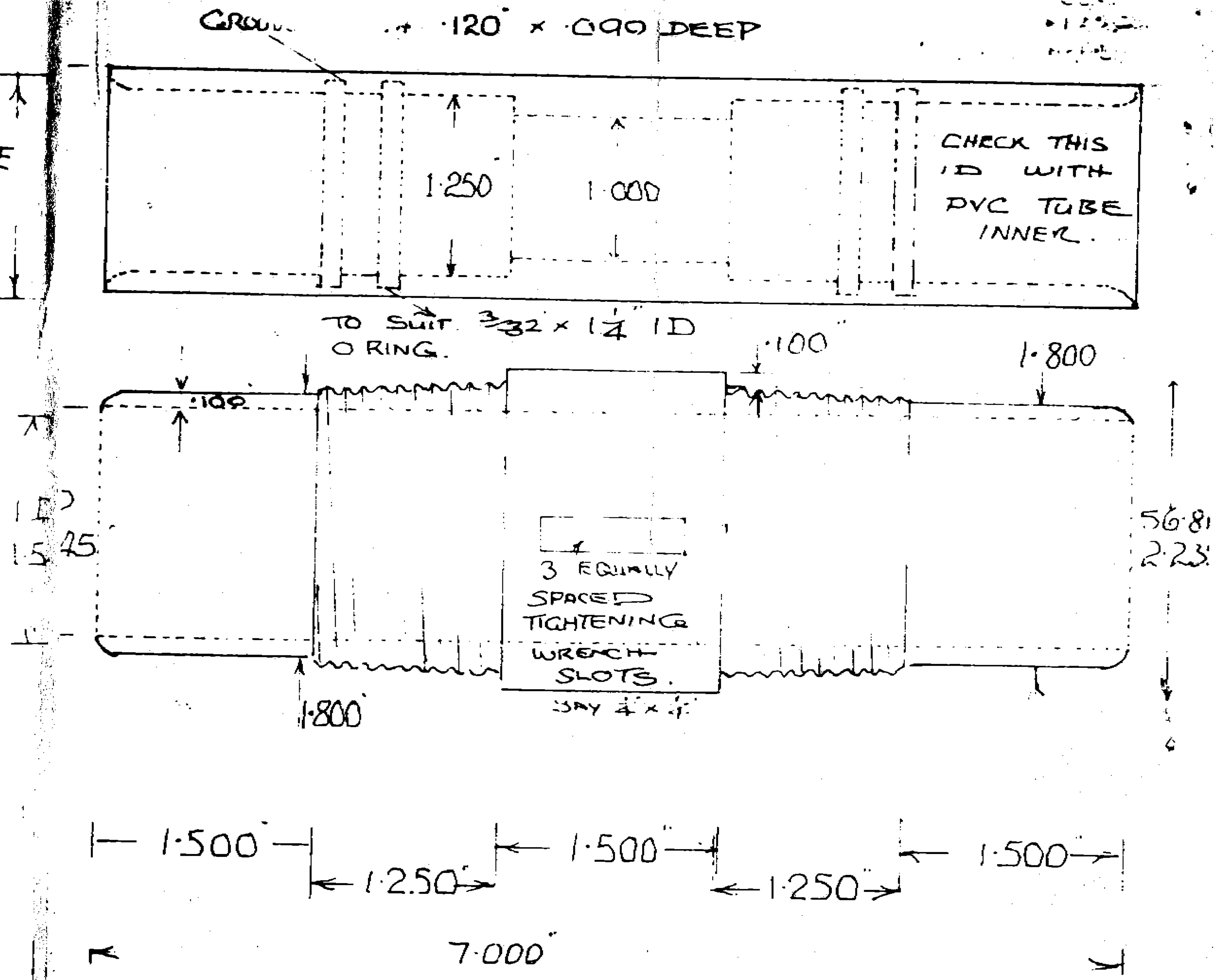
Sheet 1

OFFSHORE DRILLERS P/L

50MM - 2" SEA PROBE & S.T.P. - MULTI-PURPOSE DRILL

PATENT No 408715





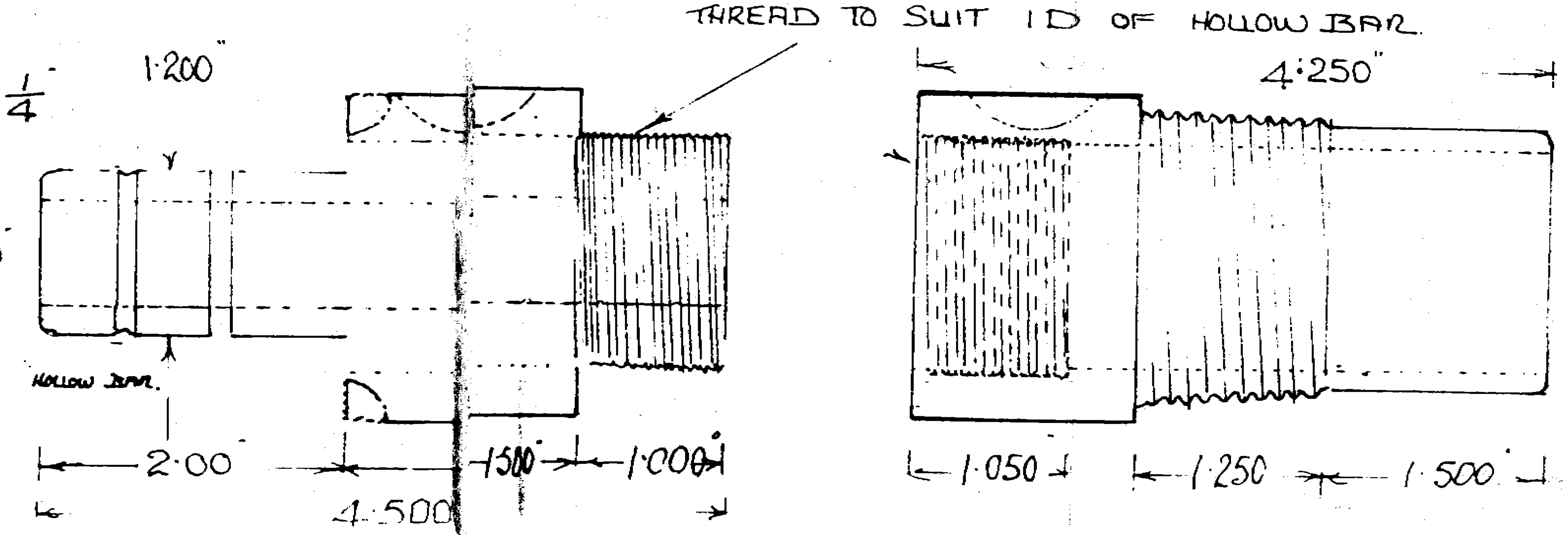
COUPLING FROM 2" — 1 1/4

HEAT SHRINK ON

304 1 1/4" OD

·048" 18 SWG S/S TUBE.

OR 20 SWG. ·036"



MATERIALS. S/S 5R60 56 × 40 MM HOLLOW BAR.

ALL 316 S/S 4'000 SOLID.

3/4" S/S FLAT PLATE PLASMA CUT.

SCALE 1:25000

METRES 1000 0 1000 2000 METRES

GRID LINES ARE 1000 METRE INTERVALS OF THE AUSTRALIAN MAP GRID, ZONE 52

MINING RESERVE & EL BOUNDARY

CONTOURS OF DEPTHS IN METRES BELOW INDIAN SPRING LOW WATER

EUPENE EXPLORATION ENTERPRISES

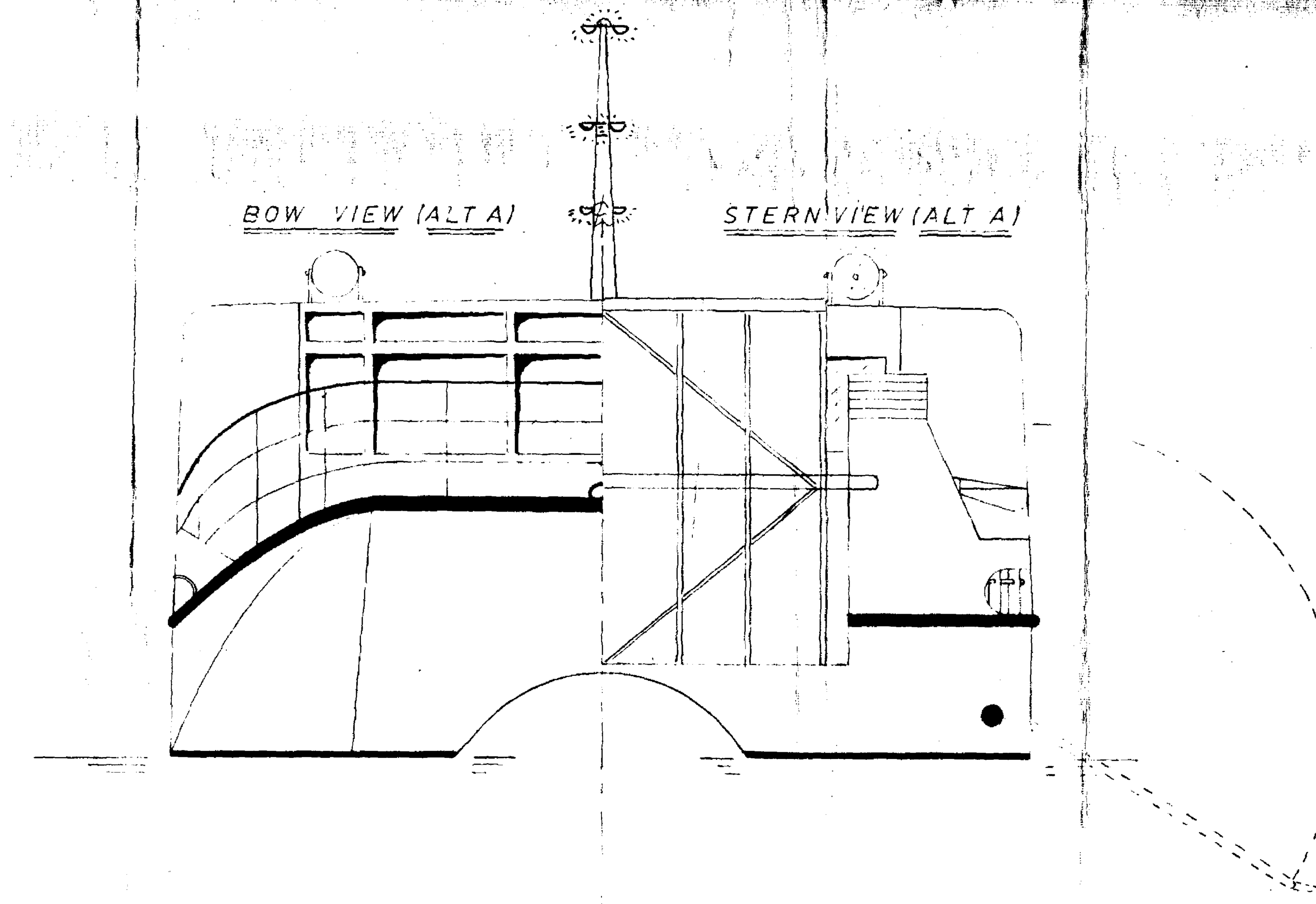
DIAGRAM PTY LTD

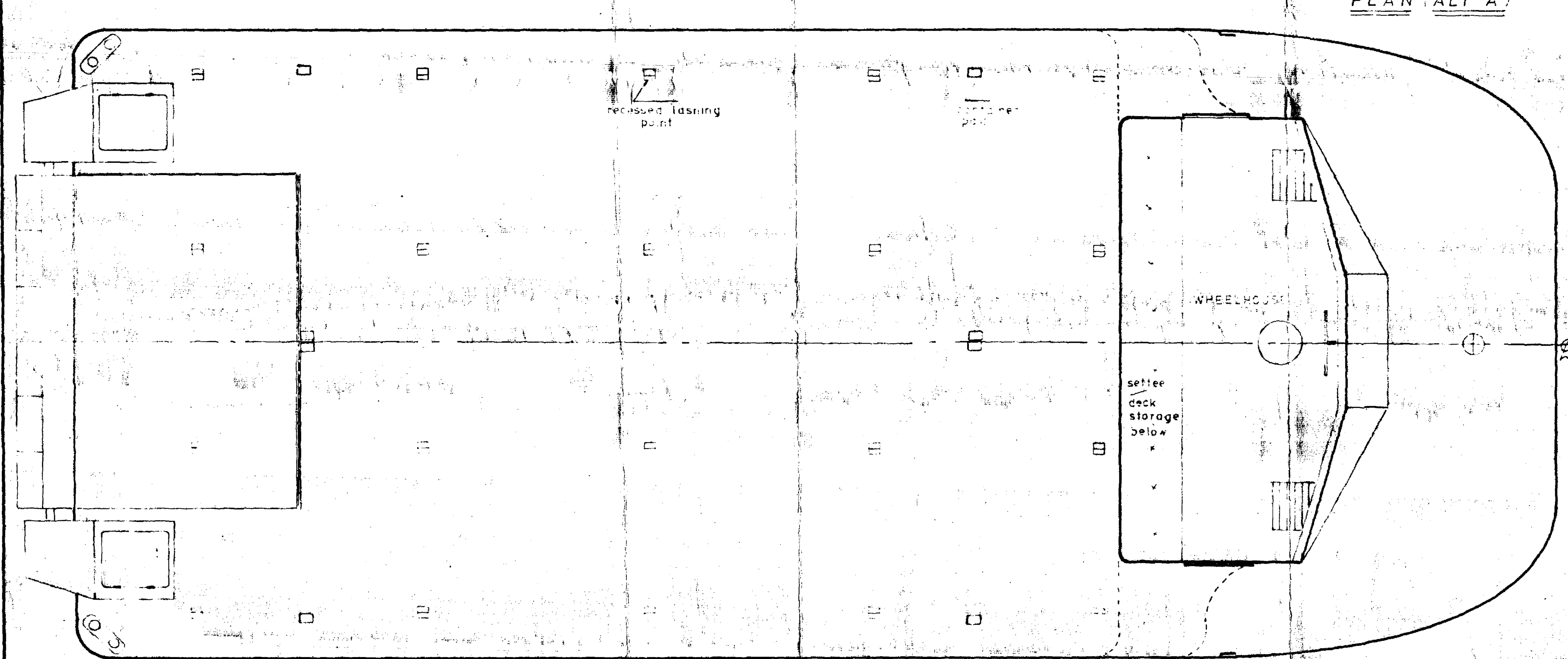
EL 1895

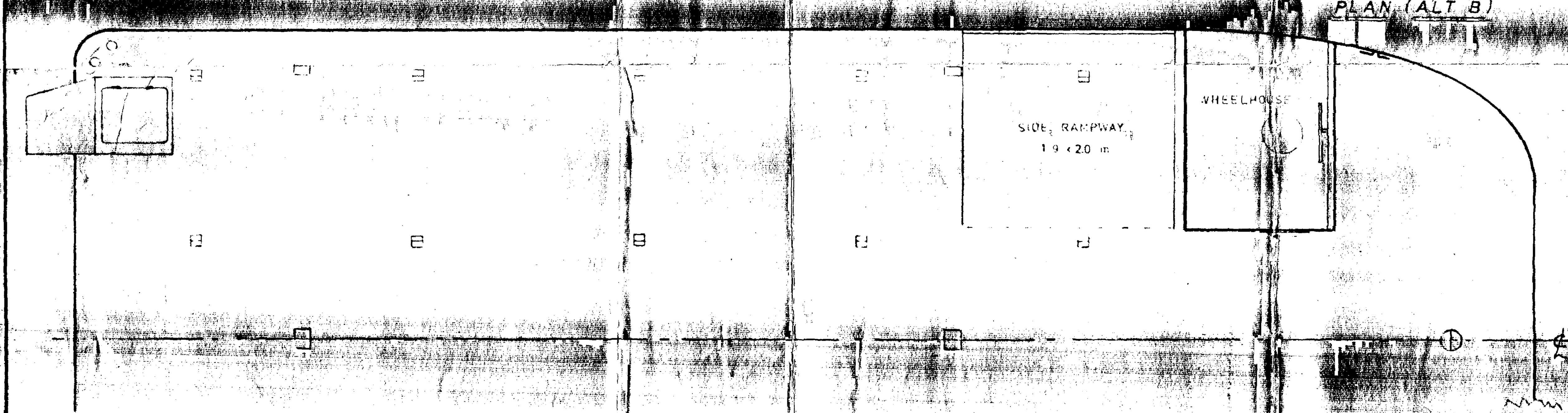
Fig 1


BYNOE HARBOUR
INDIAN ISLAND
MR 698
EL 1896
MILNE INLET
RIVER CHARLOTTE
RIVER ANNIE
8600000mN
691000mE
SCALE 1:25000
METRES 1000 0 1000 2000 METRES
GRID LINES ARE 1000 METRE INTERVALS OF THE AUSTRALIAN MAP GRID, ZONE 52
MINING RESERVE & EL BOUNDARY
CONTOURS OF DEPTHS IN FATHOMS BELOW MEAN HIGH WATER SPRINGS
EUPENE EXPLORATION ENTERPRISES
DIAGRAM PTY LTD
EL 1896

Fig 2







VESSEL DETAILS

LENGTH OVERALL	13.2 METRES
LENGTH WATERLINE	12.3
BEAM (MAX)	5.6
DEPTH	2
DRAFT (DWL)	1.2
DISPLACEMENT (DWL)	~25 TONNES (SW)
ENGINES	2 x 180 KW (CONT)
FUEL	8400 LITRES
RANGE	900 N MILES @ MCR
BOLLARD PULL	~5 TONS
DEADWEIGHT (to tunnel immersion)	~27 TONNES (SMOOTH WATERS ONLY) 34 TONNES (alum hull)
PASSENGERS (COVERED VERSION)	~115 SMOOTH WATERS [illegible]50 RESTRICTED OFFSHORE
CAR CAPACITY	7 MEDIUM SIZED (ALT A) [illegible] (ALT B)
CONTAINER CAPACITY	2 x 6m ISO TO ABOVE DEADWEIGHT
CARGO DECK AREA	54 m^2 (ALT A) 67 m^2 (ALT B)
SPEED	9 KNOTS

NB THE TUG VERSION HAS NO VENT STACKS OR RAMP AND HAS A SOLID BULWARK INSTEAD OF RAILS

Fig 10

GENERAL NOTES: ALL DIMENSIONS SHOWN ARE MILLIMETRES. DO NOT SCALE FROM DRAWINGS. ALL MATERIALS USED ARE TO BE GOOD QUALITY MARINE GRADE.

NO.	MODIFICATION	DATE
2	MODIFIED I.A.W. LINES PLAN AD	16.7
1	PASSENGER & DWT CAPACITY MODIFIED TO U.S.L. REQUIREMENTS	[illegible]

CLIENT: DIAGRAM P/L & DISPORT P/L		
VESSEL: RANGER UTILITY CATAMARAN		
TITLE: GENERAL ARRGT		
SCALE: 1:30	DRAWN: SB	DRG. NO. 2/1
DATE: 26-1-81	CHECKED: [illegible]	APPR'D

A.S.D. MARINE PTY. LTD.
P.O. BOX 1043, SOUTHPORT, QUEENSLAND, 4215
TELEPHONE (075) 32 5398

CR 82/194