明治三十三年十二月刊行

（非賣品）

造船協會會報

第四號

造船協會年報第四號

明治三十三年十二月刊行

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第一章　名稱及事務所

第一條　本會ヲ名ケテ造船協會ト稱シ其事務所ヲ東京市京橋區山城町十五番地工學會內ニ置ク

第二章　目的

第二條　本會ノ目的ハ船舶全般ノ學術技藝ヲ考究シ其發達ヲ圖ルニアリテ左ノ方法ニ依リ此目的ヲ達スルモノトス

第一　會員中造船、造機ノ技術ニ關スル有益ナル經驗、改良、發明ヲ遂ケ若クハ學理上ノ研究ヲ爲シタル者ハ務メテ其詳細ヲ會員ニ告知スル事

第二　造船、造機ノ技術ニ關スル緊要ナル試驗ニシテ一個人ノ企テ及ハサルトキハ本會ハ其依賴ニ應シ務メテ便宜ノ方法ヲ採リ其試驗ヲ完成セシムル事

第三　造船、造機ノ工業ニ關シ重要ナル問題ヲ生シ若クハ之カ諮詢ヲ受ケタルトキハ本會ハ務メテ其利害得失ヲ考究スル事

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第三條　本會會員ヲ分テ左ノ五種トス

正員

協同員

准員

名譽員

贊成員

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第五條　協同員ハ船舶ノ乘員、造兵家其他造船、造機ノ技藝又ハ工業ニ關係スル業務ニ經驗アル者トス

第六條　准員ハ造船、造機ノ專門者及船舶ノ乘員其他船體、機關、兵器ノ技藝又ハ工業ニ關係スル業務ニ從事スル者ニシテ未タ正員若クハ協同員タルヲ得サル者トス

第七條　正員協同員及准員ハ其入會申込者ニ就キ理事之ヲ承認ス

第八條　名譽員ハ社會高等ノ地位ヲ占メ又ハ大方ニ名望ヲ有シ本會ノ趣旨ヲ贊助シタル者ヨリ理事之ヲ推選ス

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第十二條　理事ハ總會ニ於テ正員及協同員ヨリ選擧スルモノトス

第十三條　監事ハ總會ニ於テ正員及協同員ヨリ選擧スルモノトス

第十四條　理事及監事ニ缺員ヲ生シタルトキハ臨時總會ヲ開キ補缺選擧ヲ爲ス其後任者ノ任期ハ前任者ノ殘期ニ止マルモノトス

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第二十四條　正員協同員及准員ハ入會金トシテ入會ノ際左ノ金額ヲ本會ニ納附スルモノトス

正員　金參圓　協同員　金貳圓

准員　金壹圓

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正員　金參圓　協同員　金貳圓

准員　金壹圓

第二十六條　正員協同員又ハ准員ニシテ一時ニ左ノ金額ヲ納附スルモノハ前條ノ會費ヲ要セス

正員　金參拾圓　協同員　金貳拾圓

准員　金拾圓

第二十七條　會員ニシテ會費ヲ納一年半ニ及フモノ又ハ本會ノ體面ヲ汚スノ行爲アリタルモノハ理事ノ議決ニ由リ除名スルコトヲ得

造船協會細則

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第七條　評議員缺ルトキハ選擧ノトキニ於ケル次點者ヲ以テ補缺シ其任期ハ前任者ノ殘期間トス但次點者ナキトキハ次ノ總會マデ補缺セス

第八條　左ノ各地ニ地方委員各一名ヲ置ク但理事ニ於テ必要ト認ムルトキハ地名及人員ヲ增減スルコトヲ得

横濱　横須賀　大阪　神戸　呉　佐世保
長崎　舞鶴　函館　鳥羽　浦賀

第九條　地方委員ハ其地方在住會員ノ便宜ヲ計リ會員ノ動靜及其地方ニ於ケル船舶ニ關スル事業ノ狀況ヲ本會ニ報告スルモノトス

第十條　地方委員ハ第八條ニ定ムル各地方ニ在住スル正員若クハ協同員中ヨリ役員會ノ決議ニ依リ理事之ヲ囑托ス

第十一條　地方委員ハ役員會ニ出席シ意見ヲ述フルコトヲ得

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第十三條　役員會ハ會長、理事、監事及評議員ヲ以テ組織ス

第十四條　役員會ハ通常毎年三月、六月、九月、十二月ノ四回ニ開ク但必要アルトキハ何時ニテモ臨時開會スルコトヲ得

第十五條　役員會ハ六名以上出席スルニ非サレハ決議ヲ爲スコトヲ得ス

第十六條　役員會ニ於テ前條ニ定メタル定員ニ滿タサルトキハ假決議ヲ爲シ其事項ヲ缺席員ニ通知シ一週間以内ニ缺席員ノ半數以上ヨリ異議ノ申立ナキトキハ其決議ヲ有効ト爲スコトヲ得

第十七條　役員會ノ決議ト雖モ理事四名以上ノ同意ナキトキハ無効トス

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第十九條　講演會ハ造船、造機ノ技術及船舶全般ノ學術技藝ニ關スル研究、經驗、改良、發明等ヲ爲シタル會員ニ於テ之ヲ講演シ又他ノ會員ニ於テ之ニ辯論批評ヲ加フルノ機會ヲ與フルモノトス

第二十條　講演會ニ於テ講演ヲ爲サントスル者ハ其旨本會ニ通告スルコトヲ要ス

第二十一條　講演通告者事故ノ爲メ講演會ニ出席セス又ハ自カラ講演スルコト能ハサルトキハ講演ノ原稿ヲ他ノ會員ニ托シ之ヲ朗讀セシムルコトヲ得

第二十二條　講演會ニハ臨時會員外ノ者ヲシテ講演セシムルコトヲ得

第二十三條　講演會ニハ會員ノ紹介ニ依リ傍聽人ノ入場ヲ許ス但傍聽人ハ會長ノ許可ヲ得スシテ會場ニ於テ辯論質問等ヲ爲スコトヲ得ス

第五章　入會、退會

第二十四條　會員タラント欲スル者ハ正員ニ在テハ正員二名、協同員若クハ准員ニ在テハ正員若クハ協同員二名ノ紹介ヲ以テ其入會ヲ申込ムヘシ但時宜ニ依リ入會申込者ノ履歷ヲ提出セシムルコトアルヘシ

第二十五條　入會ヲ承認シタルトキハ會員タルノ證票ヲ交付ス

第二十六條　退會セント欲スル者ハ其事由ヲ詳記シ申出ヘシ但會費怠納アルトキハ退會ヲ許サス

退會ノ承認ヲ受ケタルトキハ會員證ヲ返付スルコトヲ要ス

第二十七條　准員トシテ入會シタル者更ニ正員若クハ協同員タラント欲スルトキハ第二十四條ニ依リ紹介人ヲ經テ申出ツヘシ

第六章　會費

第二十八條　會費ハ一箇年分ヲ二分シ一月、七月ノ二回ニ納付スヘシ但數回分ヲ一時ニ納付スルハ隨意タルヘシ

第二十九條　新ニ入會スル者ノ會費ハ其入會六月三十日以前ナルトキハ其年一箇年分、七月一日以後ナルトキハ其年一箇年分ノ半額ヲ納ムヘシ

第三十條　定款第二十六條ニ定ムル納金ヲ爲ス者ト雖モ其納金ヲ爲ス以前ニ納ムヘキ會費ノ怠納アルトキハ別ニ之ヲ納付スヘキモノトス

第三十一條　定款第二十六條ノ納金ヲ爲シタル者死亡シタルトキハ其納金中ヨリ在會中ノ會費ヲ扣除シ殘餘アルトキハ之ヲ其遺族ニ還付ス但自カラ退會シタル者又ハ除名セラレタル者ニハ還付セス

第三十二條　前條ニ定メタル外一旦納メタル會費ハ還付セス

第三十三條　准員ヨリ正員若クハ協同員ニ轉スル者ノ入會金ハ准員トシテ納メタル入會金ニ差繼キ其不足額ヲ納付スヘシ定款第二十六條ノ納金ヲ爲シタル者亦同シ但會費ハ其年分納濟ノモノハ差繼ヲ要セス

第七章　年報

第三十四條　本會ノ記事、報告、講演及會員ノ寄稿ヲ編纂シ毎年一回發刊ス之ヲ造船協會年報ト號ス

第三十五條　年報ハ發刊ノ都度會員ニ一部宛配付ス但會費ノ怠納アル者ニハ役員會ノ決議ニ依リ配付ヲ止ムルコトアルヘシ

第三十六條　講演會ニ於テ講演ヲ爲シタル者又ハ講演ノ原稿ヲ朗讀セシメタル者又ハ有益ノ原稿ヲ寄送シタル者ニハ年報ノ外別ニ其講演ノ筆記若クハ寄稿ヲ印刷シタルモノ二十部ヲ交付ス

第八章　雜則

第三十七條　本會ノ趣旨ヲ贊助シ金員又ハ物件ヲ寄附シタル者ニハ會長ノ名ヲ以テ謝狀ヲ送リ之ヲ總會ニ報告ス

第三十八條　報酬、贈與、旅費、手當等ノ支出ハ役員會ノ決議ニ依ル

造船協會年報第四號

本會記事

○總會速記錄

明治三十三年十月二十八日午後一時開會

會務報告、豫算決算議定

○會長男爵赤松則良君　是ヨリ開會致シマス、例ニ依テ先ツ會務ノ報告ヲ致シマス、昨年ノ總會ニテ決議ニナリマシタ本會細則ノ第三條ニ依リ理事ニ於テ互選ヲ致シマシタ結果

主事ニ　進經太君　主計ニ　松尾鶴太郎君

編輯主任ニ宮原二郎君

ガ當選サレマシタ、夫レカラ此ノ細則ノ第七條ニ依テ役員會ノ決議ニテ地方委員ヲ囑託シマシタノハ

横濱ニ　宮廻惣太郎君　横須賀ニ　淺岡滿俊君

大阪ニ　小西愼三郎君　神戸ニ　津村福廣君

呉ニ　原田貫平君　佐世保ニ　高山保綱君

長崎ニ　丸田秀實君　函館ニ　山尾福三君

鳥羽ニ　清田知本君　浦賀ニ　福地文一郎君

デアリマス、何レモ御承諾ナサレタノデゴザイマス、其ノ事ハ昨年ノ年報ニ掲載シテアリマスカラ諸君ニ於テ既ニ御承知ノコトデアリマスルガ茲ニ更メテ報告致シ置キマス

夫レカラ昨年ノ七月一日ヨリ本年九月三十日マデ一年三ヶ月間ニ於ケル會員ノ異動ニ就テ報告致シマス、其ノ間ノ入會者ハ

正員ニテ　加藤知道君　山本長方君

山本金一君　江崎一郎君

佐伯平次君　山田眞吉君

協同員ニテ鶴田留吉君　服部寛司君

八戸厚一郎君　森又七郎君

平山藤次郎君　田代郁彦君

吉田新之助君　高取安太郎君

准員ニテ　山田朔郎君　野尻狂介君

兒玉徳太郎君　山田正良君

小島精太郎君　武本四七二君

豊田誠二君　山本長治君

土岐頼一君　橋本太一郎君

大塚長之君　岩澤留吉君

武野傳吉君　福島篤平君

坂戸松太郎君　菅野文吉郎君

山崎庄治郎君　今井幸太郎君
木村作助君　富永敏麿君
尾崎由藏君　平賀讓君
岩田敏雄君　橋口半次郎君
廣中義輔君　福井順平君
伊藤由一君　吉國彦二君
原正幹君　川原五郎君
新庄季九郎君　青井鉞男君
上村行榮君　永井壯吉君
牛奥勘三君　小磯勘次郎君
加藤良君　山口眞一君
鈴木四郎君

以上五十三名デゴザイマス、又准員ヨリ正員ニ轉セラレマシタノハ

福島廉平君　鶴田傳次郎君
宮廻惣太郎君　柴岡喜一郎君
清田知本君

ノ五名デゴザイマス、又退會セラレタノハ准員ノ鈴木楳吉君一名デアリマス

夫レカラ玆ニ最モ哀ムベキ報告ヲ致サナケレバナラヌコトガゴザイマス、夫レハ

名譽員吉島辰寧君　正員河崎民樋君
協同員成田友久君　准員山本薑三郎君
准員篠島祿郎君　准員尾崎由藏君
准員倉持一三君　准員手塚次君

ノ八名ガ死亡セラレタノデ誠ニ哀悼ノ至リデゴザイマス

此ノ入會退會等ヲ差引マシテ本年九月三十日ニ於ケル會員ノ數ハ

名譽員　二十四名　賛成員　十五名
正員　七十八名　協同員　三十六名
准員　百三十四名

合計二百八十七名デゴザイマス、昨年ノ總會ノトキヨリ四十四名増シタコトニナリマス

正員志道貫一君ヨリ製圖用ノ定規一箱ト文鎮一箱ヲ本會ヘ寄附セラレマシタ、厚ク謝意ヲ表シマス

夫レカラ獨逸國伯林ノ造船協會ヨリ其ノ會ノ年報ヲ送リ越シマシテ本會ノ年報ヲ送ッテ呉レル樣ニト申込ガゴザイマシタ、夫レデ互ニ年報ヲ交換スルコトニ致シマシタ

本會モ追々海外諸國ニ名聲ガ弘マリマシテ本會ノ年報ヲ要望致シマスル向キモゴザイマス、昨年ノ年報ハ露西亞、英吉利、獨逸、伊太利、北米合衆國等ノ有名ナル技術家又ハ技術ノ協會等ヘ送付致シマシタ、彼樣ナ次第デ追々外國人ノ入會ヲ希望スル者モアル樣子デゴザイマス

カラ外國人モ會員ニ入レルコトニ致シマシタ、夫レデ我邦ノ造船事業並ニ其ノ技術ノ進歩ガ外國人ノ注意スル所トナリマシタノハ取リモ直サズ我邦ノ名譽ト申シテ然ルベキコトデゴザイマス、諸君ト共ニ誠ニ喜ブベキコトト存シマス、夫レニ付テハ尚ホ一層斯學ヲ研究シテ我邦技術家諸君ガ益々我國光ヲ宇内ニ宣揚セムコトヲ勉メラレムコトヲ希望スル次第デゴザイマス

是ヨリ會計ノコトニ付テ報告ヲ致シマス、昨年ノ七月一日ヨリ本年九月三十日ニ至リマスル間ノ決算デゴザイマス

一金六百四拾貳圓拾四錢　收入總額

內

金四拾六圓　入會金
金五百參圓五拾錢　會費
金九拾壹圓八拾九錢　預ケ金利子
金七拾五錢　雜收入

一金四百九拾壹圓四拾貳錢九厘　支出總額

內

金參拾七錢　備品費
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差引

金百五拾圓七拾壹錢壹厘　殘額

一金千九百八拾六圓五拾六錢七厘　前總會報告ノ殘額繰越

合計金貳千百參拾七圓貳拾七錢八厘　現在金額

右ノ通リデゴザイマシテ此ノ現在金額貳千百參拾七圓貳拾七錢八厘ハ本會ノ資產ニ屬スベキモノデ夫々確實ノ方法ヲ以テ理事ニ於テ保管致シテ居リマス、尚ホ詳シイコトヲ御承知ニナリタケレバ主計ガ持テ居リマスル帳簿ニ就テ御覽下サレトウゴザイマス、此ノ金高ハ昨年報告ノ決算ニ較ヘマスルト收入支出トモ金高ガ少々增シテ居ル樣デアリマスガ當年ノハ七月カラ九月マデ三ケ月多イカラ金高モ殖エテ居ル譯デゴザイマス、此ノ決算ハ定款第二十三條ニ依リマシテ諸君ノ御承認ヲ請ヒマス

御質問ガアリマスレバ主計ヨリ辨明致シマス、御質問ガアレバ御發議ナサツテ下サイ

別ニ御異存ガゴザイマセヌバ御承認ニナツタモノト認メマス、夫レデハ可決ト致シマス

夫レカラ又定款第二十三條ニ依リマシテ本年十月一日ヨリ來年九月三

十日迄ノ一年間ノ經費豫算ヲ提出シテ諸君ノ御協賛ヲ得ナケレバナラヌノデアリマス、之レハ是丈ケノ收入ガアル之レハ是丈ノ支出デヨロシイト確ナ豫算ヲ立テルト云フコトハ誠ニムツカシウゴザイマスガ、別段臨時ノ費用ガゴザイマセヌケレバ昨年ノ決算ノ金額ヲ以テ此ノ先キ一ケ年ノ豫算トシテ御協賛ヲ得タイト存シマス、如何デゴザイマスカ、別段御異存ガ無クバサウ致シテ置キマシテ、豫算可決ト致シマス

夫レカラ今一ツ報告致シマス、是ハ唯今報告シマシタ決算締切ノ後チ當月ニナツテ淺野總一郎君ヨリ金百圓本會ニ寄附セラレマシタニ付キ賛成員ニ推選致シマシタ

夫レカラ協同員山崎定信君ガ當月二十三日ニ死亡サレマシタ、誠ニ哀ムベキコトデゴザイマス

是レデ會務ノ報告ハ終リマシタ

細則中改正案議事

○會長男爵赤松則良君　是ヨリ豫テ諸君ヘ御廻シ致シ置キマシタ本會細則中改正案ノ御協議ヲ願ヒマス

此ノ改正ヲ必要トシマシテ此ノ案ヲ提出シタ理由ト申シマスルハ此ノ細則第十條ニ「役員會ハ會長理事及監事ヲ以テ組織ス」トゴザイマシテ僅カノ人數デアリマス、此ノ少人數デ一切ノ事ヲ決行スルハ餘リ宜シクナイト云フ樣ナ感ジモアリマスルシ又近頃ハ役員ノ内ニテ代ルゝゝ外國ヘ出張スル者ガ出來マシテ役員會ガ成立セナイ樣ナコトニナリマス、夫レダカラト云ツテチヨツト外國ヘ行クトテ其ノ度每ニ役員ヲ辭セラレテハ又其ノ度每ニ補缺選擧ヲシナケレバナラヌ、補缺選擧ヲスルニハ臨時總會ヲ開カナケレバナラズ中々手數ガ掛リマスルシ又サウ度々役員ニ變更ガアツテハ御同樣ニ迷惑ノコトデゴザイマス、旁々大ニ不便ヲ感ジマシテ茲ニ評議員ヲ設ケマシテ役員會ノ人數ヲ殖ヤシタナラバ外國行ノ人ガ出來テモ夫レガ爲メ役員會ノ成立セナイ樣ナコトハナイ會ノお流レニナル樣ナコトハナイ、又少數デ事ヲ決スルハ面白クナイト云フ樣ナ感ジモナクナリ都合ノ好イコト、存シマス、夫レナラ理事ヲ多クシテハ如何カト云フ說モ起ルカト存シマスルガ、理事ヲ殖ヤスニハ定款ノ改正ヲシナケレバナラヌ、ソウシテ其筋ノ認可ヲ受ケテ理事ノ人名住所等ハ夫々裁判所ニテ登記スルノデアリマス、誠ニ面倒ナモノデアリマス、其ノ理事ガ轉居スルニモ登記換ヲ致サヌケレバナラヌノデアリマシテ人ガ殖エレバ殖エル丈ケ手數ガ增ス譯デゴザイマス、實ハ理事ヲ少ナクシテ評議員ヲ多ク致シタ方ガ宜シイト考ヘルノテスガ夫レモ定款ヲ改正セネバナリマセヌカラ、ソコデ定款ニ差障リノ無イ樣ニシテ細則ノ内ニ評議員ヲ置クコトニスル、其ノ評議員ハ理事監事同樣ニ本會ノ事務ヲ議セラレタイノデアリマス、此ノ改正案ハ第二章ノ中ヘ第五條第六條第七條ト云フノヲ新タニ加ヘ、サウシテ元ノ第五條以下ヲ順次ニ繰下ケルト云フ簡單ナモノデスカラ逐條審議トスルニモ及ビマスマイカラ其ノ手續ヲ省キ此ノ決議案全體ヲ議題ト

シテ議決シタイト思ヒマス

決議案

造船協會細則中左ノ通リ改正ス

第二章　評議員及地方委員

第五條　本會ニ評議員五名ヲ置キ役員會ノ議事ニ參與ス

第六條　評議員ハ總會ニ於テ在東京ノ理事及監事外ノ正員及協同員中ヨリ選擧シ其任期ヲ三年トス

第七條　評議員缺ルトキハ選擧ノトキニ於ケル次點者ヲ以テ補缺シ其任期ハ前任者ノ殘期間トス但次點者ナキトキハ次ノ總會マデ補缺セス

元第五條ヲ第八條トシ以下順次條數ヲ繰下ク

元第十條(改正第十三條)中「及監事」ヲ「監事及評議員」ト改ム

○水谷叔彦君　チヨツト私ハ不審ガアリマスカラ伺ヒマス、此ノ議案ノ第六條ニ評議員ハ其任期ヲ三年トストアリマス、他ノ役員ノ方モ三年デ明年ハ改選ノ期ト云フ樣ニ承知シマスガ、若シ今度之レガ成立シテ評議員ガ就任サレルト次ノ改選ハイツニナリマスカ、ソコヲ承知シタイ、他ノ理事及監事ト同樣ニ明年改選ニナリマスカ、或ハ三年ト云フコトデゴザイマスカ

○會長男爵赤松則良君　今度評議員ガ新選ニナリマスト其ノ時カラ數ヘテ三年ト云フコトデゴザイマス

○水谷叔彦君　私ノ御尋ヲシタ趣意ハ斯ウ云フノデゴザイマス、是レハ同時ニ改選シタ方ガ便宜ト思ヒマス、理事ト申シマスト非常ニ會ノ方ノ事ニモ忙シイ事務ガゴザイマシテ御承諾ヲ願ヒマスニモ願ヒカネル御方ガアラウト思ヒマス、サウシマストサウ云フ理事ヲ願ヒタイ方ニ評議員ヲ願ツテ置キマスト會ノ爲メニ差支ヘルト思ヒマス、ソレヲ同時ニシマスト投票ヲスルニ便宜ガ宜イカト思ヒマス、若シ今日カラ三年ノ任期デアツテ、外ノ理事監事ト違フト云フコトデアリマスレバ私ハ之ヲ一緒ニシタイト考ヘテ居リマスカラ議案全體デ決ヲ御採リニナラヌデ逐條ニ御採リニナル樣ニシタイト思ヒマス

○佐雙左仲君　唯今水谷君カラノ御説モアリマスガ此ノ役員ハ成ルベク一時ニ變更セヌ方ガ私ハ宜シカラウト思ヒマス、水谷君ノ御心配モアリマスガ、評議員ヲ理事ニシマスルト評議員ノ缺員ト云フコトニナリマスカラ此ノ改正案ガ決議ニナレバ第七條ニ依テ評議員ヲ補缺シテ宜イト思ヒマス、矢張リ評議員ノ任期ハ今日ヨリ先キ三年トシタ方ガ宜イ、一時ニ之ヲ改選スルノ必要ハ無イカト思ヒマス

○井口在屋君　私ハ水谷君ニ贊成シマス、サウデアリマセヌト評議員ニ一旦當選シマシテ次期ノ理事監事ノ改選ニ當リマスト現ニ評議員デアル人カラハ更ニ理事監事ニスルコトガ出來ナイ、サウスルトソコニ不便ヲ感スルノデゴザイマス

○松尾鶴太郎君　唯今水谷君カラシテ評議員ハ理事監事ト同時ニ改選

スル方ガ便利デアルト云フ御説ガ出マシタ、至極御尤モト考ヘマスガ、併シ此ノ議案ニ依ルト第六條ニ評議員ハ總會ニ於テ在東京ノ理事及監事外ノ正員及協同員中ヨリ選擧スルト云フコトデアリマス、是レハ評議員ト云フモノハ理事監事外ニ選擧スル規定デアッテ、評議員カラ理事ヲ選ムハ差支ヘナイガ、理事カラ評議員ヲ選ムコトヲ避ケタイ爲メニ特ニ斯様ニ規定シタモノデアッテ、是レハ佐雙君ノ御説ノ通リ評議員ハ理事監事ト時ヲ異ニシテ選擧シタイト思ヒマス

○會長男爵赤松則良君　サウスルト水谷君ノハドウ云フ様ニ改メヤウト云フノデゴザイマスカ

○水谷叔彦君　此ノ議案ニハ任期ヲ三年トストゴザイマスガ、改選ト云フコトハ現在ノ理事監事ノ改選ト一緒ニスルト云フコトニナレバ私ノ意ハ充ツル譯デゴザイマス

○會長男爵赤松則良君　夫レデハ水谷君ノ御説ニ御同意ノ方ガ多ケレバサウナリマスシ、少ナケレバ消滅シマス

○和田垣保造君　私ハ評議員ヲ偶數ニシテ半數ハ今カラ三年、半數ハ理事監事ト同シトキニ改選スルコトニシタラ兩方ノ欲スルトコロハ滿足シマセウト考ヘマスカラ仲裁説ヲ提出シマス

○會長男爵赤松則良君　今和田垣君カラ御説ガ出マシタガ、贊成者ガゴザイマスカ、贊成ナサル方ガゴザイマセヌカラ和田垣君ノハ議題トシマセヌ

○和田垣保造君　夫レナラ原案ニ贊成シマス

○寺野精一君　水谷君ノ説ニ贊成

○會長男爵赤松則良君　夫レデハ決ヲ採リマス、水谷君ノ説ニ贊成ノ方ハ起立

起立者　少數

○會長男爵赤松則良君　少數デゴザイマス、原案ニ就テ決ヲ採リマス此ノ提出ノ決議案全體ニ贊成ノ方ハ起立

起立者　多數

○會長男爵赤松則良君　夫レデハ原案ノ通リ可決ニナリマシタ

評議員撰擧

○會長男爵赤松則良君　今日ノ議題ガ決シマシタニ依リテ唯今此ノ席ニテ評議員ノ選擧ヲ行ヒマス、豫テ投票用紙ガ御廻シ致シテアリマスカラ夫レニ評議員五名ノ御投票ヲ願ヒマス

（投票執行）

（投票ヲ計算ス）

○會長男爵赤松則良君　投票ノ結果ヲ報告致シマス

當選者

二十點　寺野精一君　　十九點　近藤基樹君

十六點　須田利信君　　十一點　和田垣保造君

八點　小幡文三郎君

次點者

七點 水谷叔彦君　六點 平山藤次郎君
五點 內藤政共君　五點 小島門彌君
四點 山崎鶴之助君

デゴザイマス、是レニテ總會ヲ了リマシタ

○講演會　講演會ニ於テ左ノ講演アリ

インデペンデント、エーアパンプ　和田垣保造君
驅逐艦ニ就テ　近藤基樹君
揚子江航行輕喫水船　小西愼三郎君
近時ノ商船　寺野精一君

○懇親會　十月二十八日午後七時講演會解散ノ後京橋區釆女町精養軒ニ於テ會員有志者懇親會ヲ開ク出席者左ノ如クナリシ

伊藤辰吉君　井口在屋君　今岡純一郎君
小幡文三郎君　大木治吉君　小野俊夫君
和田垣保造君　加茂正雄君　橫田成年君
子爵內藤政共君　野尻狂介君　熊倉達君
山田鉎太郎君　山田朔郎君　山田眞吉君
山本幸男君　松尾鶴太郎君　小西愼三郎君
香坂季太郎君　小島門彌君　近藤基樹君
寺野精一君　男爵赤松則良君　淺岡滿俊君
佐波一郎君　佐雙左仲君　宮原二郎君
宮廻恕太郎君　水谷叔彦君　男爵鈴木大亮君

○主計變更　主計松尾鶴太郎君英國ヘ出張ニ付理事ノ互選ヲ以テ佐雙左仲君ヲ主計ト定メタリ

○入會者　總會後ノ入會者左ノ如シ

正員　石川綾治君
協同員　中山秀三郎君
協同員　服部漸君
協同員　葛藏治君
准員　山本幸男君
准員　金田和三郎君

○地方委員變更　呉地方委員原田貫平君佐世保地方委員高山保綱君轉居ニ付役員會ノ決議ヲ以テ更ニ左ノ通リ囑託シタリ

呉地方委員　青木恭君
佐世保地方委員　原田貫平君

明治三十三年十月二十八日造船協會講演會ニ於テ

ON INDEPENDENT AIR PUMPS.

By

Y. Wadagaki. Member.

Generally speaking there are two Principal methods of operating the marine engine air pumps; namely,

(a) Deriving its motion from a part of the main engine, such as the piston, cross head, crank shaft, &c.

(b) Providing a special steam engine to drive the pumps.

Of these two methods, the first is undoubtedly more economical in the consumption of steam, requires less space and weight for a given work to perform, and is surer in its operation. But the preference of our Navy Department has been for the independent air pumps for the following reasons: –

(1) In getting up the steam and warming the main engine cylinders, the independent air pumps can take care of the condensed steam without waste.

(2) With independent air pumps in operation, there is always a good vacuum in the condenser, so that the execution of orders or the handling of the main engines is rendered very easy.

(3) When, from a sudden stoppage of the main engines or other causes, more steam is generated in the boiler than is wanted, recourse may be had to the silent blow-off, and the loss of a considerable amount of fresh water avoided.

(4) The air pumps attached to the main engines suffer a great deal, when the main engines are subjected to racing in a heavy sea.

(5) With air pumps attached to the main engines, the failure of the pumps would disable the whole engines for some time at least; but with a separate air pump engine, the main engines may continue their motion, while a substitutional means are temporarily employed to empty the condenser.

(6) Air pumps, attached to the main engines, which are larger than necessary at high powers may be too small at low powers. But the independent air pumps can be made to suit their speed to the requirements of the case.

For these reasons, even with an air pump attached to the main engine, it is very important that a small separate pump should be provided to take its place when the maine engine is not running. Independent air pumps, however, are not without drawbacks. We have had troubles enough in connection with independent air pumps fitted to some of our recent war vessels. It is far from the intention of the present writer to find fault with any one who has had any thing to do with the designing of these air pumps. We all make mistakes, and we learn only through experience.

The writer does not claim any originality for what he is going to state. In fact, the subject has been well thrashed out by eminent engineers of Europe and America over and over again. And what follows is simply a resumé of results obtained by a long series of our common experience with this type of air pumps in the navy. Now, the greatest trouble with an indenpedent air pump is the difficulty of controlling its motion. This arises from a peculiar condition under which the pump is working. To illustrate what is taking place inside the pump barrel, let us take a single acting vertical air pump. Suppose the bucket is at the bottom end of its stroke, about to commence its upward stroke. As it is impossible to build a pump without clearance, we have a certain amount of space between the foot valve and the bucket valve, occupied by the condensed water or air. As the bucket moves upwards, the volume of this space is increased. The air in this space expands. The warm water on the foot valve begins to evaporate to maintain the state of equilibrium between temperature and pressure of the vapour in this increasing space. A point is at last reached when the pressure of vapour under the bucket valve is sufficiently reduced to enable the foot valve to lift itself. How soon this point is reached depends on the amount of clearance mentioned above, the tension of air and vapour existing in the condenser, the head of water in the air pump suction pipe and also on the weight of the foot valve itself. To get the best result this clearance should be made as small as practicable, consistent with strength and durability. The lead of the suction pipe must be made straight, sloping down from the bottom of the condenser toward the pump suction, so that the condensed water should flow to the pump by its own weight, undisturbed.

The pressure in the condenser depends on two things: the amount of air present in the condenser, and the tension of vapour corresponding to the temperature which it maintains. The relative quantity of air and vapour contained in the condenser can easily be ascertained, as it is well known that the resultant pressure of a mixture of two gaseous substances contained in a closed vessel is equal to the sum of two different pressures that they would have individually, if contained in two vessels of the same volume separately, and that the tension of saturated steam depends only on its own temperature under all circumstances, and would remain constant so long as its temperature remains the same. The tension of the vapour can be reduced by increasing the amount of circulating water. As to the amount of air in the condenser, the principal source of its presence is the leakage of atmospheric air through the low pressure stuffing boxes or the joints of exhaust steam pipes. Therefore too much care can not be exercised to see that they are working air-tight. The leakage is liable to take place at all powers, but especially so at lower powers. A certain amount of air is also carried with feed water into the boiler, gets mixed with the steam, and after going through the engine cylinders ultimately finds its way to the condenser. Hence, it is very important that the air pump delivery to the feed tank should take place very quietly to prevent any air getting dissolved into the feed. It is not always practicable to carry out the water pressure test at sea to discover the leakage of air through the pipe joints, &c. When the engine is under weigh the application of candle light at the suspected points is the easiest method of detecting the leakage that is going on. Now to resume the study of our air pump, let us examine what is taking place on the top side of the bucket valve during the same upward stroke. At the beginning of the stroke, the difference of pressures between the top and bottom sides of bucket is almost nothing, and may be represented by the weight of the bucket valve. There is therefore almost no load or resistance to the motion of the bucket valve, except a slight mechanical friction and the force required to lift and accelerate the dead weight of the working parts. As the bucket goes up, the air and vapour between the head valve and bucket valve get compressed. A part of the vapour is condensed, but the air contained in the pump barrel will have its pressure increased, until at last it exceeds the atmospheric pressure on the head valve. How soon this state of things takes place depends, as before, on the clearance between the head and bucket valves, the amount of air and water on the bucket, the tempetature of vapour, and the weight of the head valve with water upon it as well as the atmospheric pressure. The height of water above the head valve is of course determined by the level at which it is kept in the feed tank. The valves that combine lightness with durability are those made of layers of sheet metal, trimmed in the shape of circular discs of different diameters with a number of lubricating holes on them except the bottom sheet. It is not possible to reduce the clearnce space beyond a certain limit; but, its pernicious effect can be avoided somewhat in one way or another. One easiest and most obvious method is to give the longest possible stroke to the pump. Another, not less effective, means of getting at the same result is to run the pump at a very slow speed, so as to have a certain amount of comparatively quiet water on the bucket, which would fill up the clearance space at the end of the upward stroke and allow all the air to escape through the head valve without much disturbance. At the commencement of the return stroke, we have a pressure slightly above that of the air on the bucket valve, and underneath the valve a partial vacuum which is a little better than that in the condenser itself. There is therefore no resistance to the downward motion of the bucket valve, except a slight mechanical friction. In fact every thing is ready to descend by its own weight, assisted by the excess of pressure on the top side of the valve over that underneath it. If any amount of air should remain in the clearance space above the bucket valve, it would expand as the bucket descends; at the same time the re-evaporation of water on the bucket would take place more or less. The general tendency of these is to retard the reduction of pressure on the top side of the bucket. Below the bucket valve, the air is being compressed as the bucket descends. The clearance space between the foot and bucket valves has also the same tendency to retard the accumulation of pressure underneath the backet valve. It is only after the pressures on two sides of the bucket valve have become equal that the bucket valve commences to open itself. Here again, the water on the foot valve would do the duty of virtually reducing the clearance space, so long as the pump is working slowly enough to preserve the water level on the foot valve. The water kept on the valve not only serves to minimize the bad effect of the clearance space and any pocket where the air may be entrapped it is also the most effective means for the prevention of leakage of air through the valve. All this explains why the single acting vertical air pumps are so very much superior to the double acting horizontal ones. With the latter type of air pumps, moreover, not only is the clearance space extravagantly large, it is also impossible to obtain the benefit of the water-covered valves. Even with a vertical air pump, the water would not remain quietly on the bucket valve, if its working speed exceeds a certain limit. In order that the water on the bucket valve should not leave it till the end of the upward stroke, the retardation of the bucket after the middle of its stroke must never exceed the downward acceleration of water on the bucket, due to the force of gravity. Assuming uniformity in the angular velocity of the crank, and neglecting the influence due to the obliquity of the connecting rod, this limiting speed would be given by the equation

$$N = \frac{215}{\sqrt{S}}$$

where N is the number of revolutions per minute and S the stroke in ins. Thus if the stroke of the pump bucket be 9 inches, then in order that the delivery should take place in a quiet and steady manner, leaving enough water on the bucket to fill up the prejudicial clearance space, the speed must not exceed

$$N = \frac{215}{\sqrt{9}} = 72 \text{ per minute approximately.}$$

The loss of efficiency, due to the excessively high working speed of the bucket is greater when the lift of the valve is too large; for, then the action of the valve would become very indefinite; and the two sides of the valve would be kept in communication, when they ought to be shut off from each other. Prejudicial effect of this kind is felt less in the case of single acting pumps than in the case of double acting ones; because, the delivery chamber is separate from the suction chamber, and the bad vacuum above the bucket does not cause a bad vacuum below. For all that, it is very desirable to work the pump within the limiting speed as indicated above.

A great difficulty with an independent air pump engine, working on ordinary steam distribution, is that it can not be run at a slow speed, as it is very liable to stop at the slightest change in the amount of load or resistance. This arises from peculiar circumstances under which it is working. We have already seen that the whole work of a single acting vertical air pump is done during the upward stroke, and almost nothing during the return stroke. At the top end of the stroke, every piece of the reciprocating parts is ready to descend by its own weight; and the assistance given to it by the difference of pressures between the two sides of the bucket is more than enough to start the motion. The steam admitted to the top end of the cylinder, under these circumstances, is not only entirely superfluous, it is, on the contrary, very injurious to the smooth running of the engine. Any one who has stood watch beside this sort of air pump engines would know in what a laborious manner the crank moves round during the upward stroke and how suddenly it jumps down the moment after it has reached the top end of the stroke. Should he happen to open the main bearings and examine them, he would indeed be surprised to notice a great deal of hard beatings which the bottom brasses had had to bear while the top ones had hardly been touched. In the case of a double cylinder air pump engines, this jerky motion could be remedied somewhat by setting the pair of cranks nearly opposite, so that each crank would work for its own pump during the upward stroke, and for the adjacent pump during the return stroke, alternately. With this arrangement of cranks, however, the starting of the engines becomes a matter of great difficulty. In an ordinary steam engine with a uniform load, the provision of a fly wheel of moderate size is quite enough to enable the crank to get over the dead points. Not so with air pump engines, working on ordinary steam distribution. The reason is not far to seek. As we have already seen, there is little or no resistance at the beginning of either stroke. A very slight opening of steam stop valve would be quite sufficient to commence the stroke, but the increasing resistance towards the end of the upward stroke, due to the pressure of air compressed between the head and bucket valves would ultimately stop the onward motion of the reciprocating parts, unless more and more steam is admitted to overcome the resistance. If the opening of the steam stop valve had been made sufficiently large in anticipation of this increasing resistance, then the motion of the crank after passing over the dead centre would be so violent as to endanger the safety of the working parts. Whole trouble lies in the wrong distribution of steam. When there is a minimum of resistance, full initial pressure is applied. After cut-off the steam expands, the pressure falls to the terminal point, and then we have to encounter the greatest resistance that can take place during the whole revolution. No wonder then that the pump would stop. The operation is particularly trying when, beside the irregularity of load, inherent to the action of the pump itself, there do exist external causes such as sudden variations in the power of main engines, with the corresponding change in the amount of air and condensed water, the rolling and pitching of the ship, etc, which makes the water supply in the suction pipe intermittent. The pump designed for a certain power of the main engines may be too small or too large for another power. But, within a certain limit, the size of the air pump has very little influence on the vacuum that can be maintained in the condenser. For, if there is any tendency to make the vacuum worse, more air would be pumped out each stroke, by the same pump. And the pump that is too small suffers less from the fluctuation of the work to be done than the pump that is too large, as the supply in the suction pipe could be made less irregular on account of the smaller quantity of air or water that it has to pump out per stroke. To insure a steady, continuous and uniform supply of water in the suction pipe of an air pump, it must be located as near the condenser as possible, especially in transverse direction. Another fact which is very characteristic of air pump engines is that when the speed of the pump is increased, the load on the pump is decreased; for, whatever may be the working speed of the pump, the work to be done per unit of time remains constant, so long as the same conditions are maintained at the main engines. This is another cause which contributes to the difficulty of controlling the motion of an independent air pump engine. A smaller air pump is better off in this respect than a larger one. Defect of this kind could be remedied to some extent by working the air pump in conjunction with some other auxiliary engines, such as the centrifugal pump in which the resistance would increase with the increase of speed. The fly wheel gives us another means by which we could regulate the irregularity of crank motion more or less. It is certainly a very useful appendage to an ordinary steam engine; it requires, however, an enormous diameter to be effective for the regulation of an air pump engine, and is therefore a not very desirable fitting on board a war vessel, where the weight and space is of a paramount imporrance. An air pump engine with three cranks is said to have given a fairly good result. But, the best of all methods is so to adjust the distribution of steam in the cylinder as to meet the varying load on the bucket of the pump at the right moment, in such a way that the indicator cards taken from the steam cylinder should in effect imitate those taken from the pump itself. Such an engine as this assisted by a fly wheel of moderate size would work tolerably well. Suppose we are considering the design of a double cylinder single acting vertical air pump engine. Let the cranks stand at right angles to each other. With this arrangement of cranks the motion may be a little jerky but the pump would be less liable to stop, than with cranks set nearly opposite. From what we have seen before, it is evident that the proper distribution of steam for the engine under consideration should be such as would satisfy the following conditions:—

(1) During the upward stroke the admission of steam should be continued to the end of the stroke without cut-off.

(2) Where practicable, the bottom steam port may even be left open to the steam instead of to the exhaust, during an early part of the return stroke.

(3) No compression is wante on the top side of the piston, at the end of the upward stroke; for, the air compressed on the bucket would be more than enough for the requirements of the case.

(4) No lead need be given to the top steam port at the beginning of the downward stroke; for, as was already explained, every piece of reciprocating parts is ready to descend by its own weight. In fact, the lead may even be made a negative quantity, in this case.

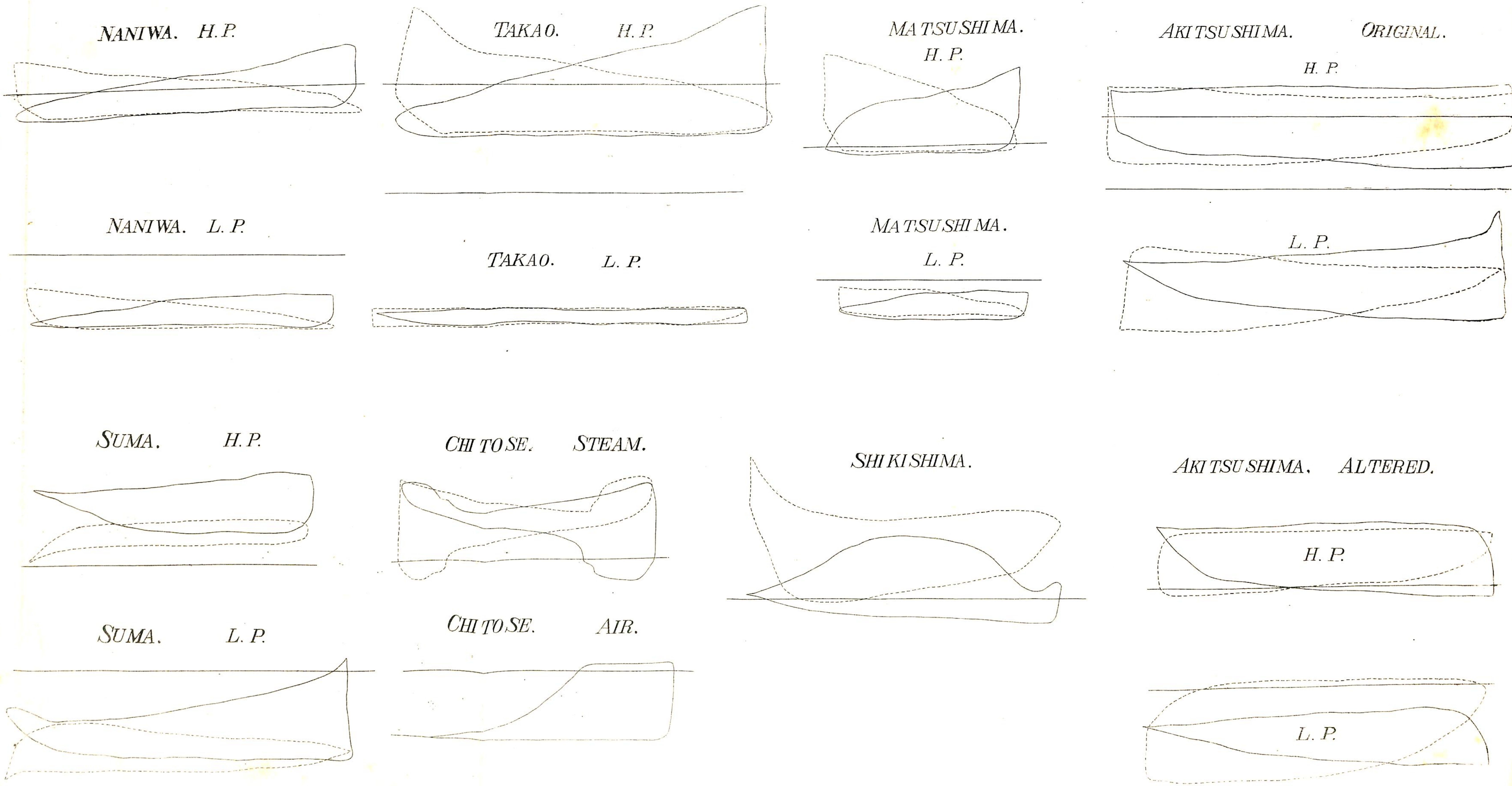
(5) During the downward stroke, the steam should be cut off, not later than the middle of the stroke.

(6) Towards the end of the downward stroke, the compression and admission of steam should take place as early as possible, to cushion up the heavy mass of reciprocating parts which is jumping down upon the main bearings. Most of these requirements could be answered by giving different amount of laps to the edges of the slide valve. But, if it were the question of making suitable alterations to an already existing engine, the above conditions could be satisfied more or less by shifting the centre of the slide valve toward the top, or by pushing the centre of the excentric backward. An automatic governor is a good thing to regulate the speed of an engine. But, on board a vessel that is sometimes subjected to heavy rolling and pitching, any governor acting on the principle of weight and centrifugal force does not give a very satisfactory result. On the

contrary it may be a source of troubles in itself. A better plan would be to take advantage of the wire-drawing action of steam, by giving very contracted area to the steam and exhaust ports of the cylinder. The latest practice is to make the top steam port about one-hundredth part of the piston area and the bottom one about one-fiftieth. If desired, valves or cocks may be fitted to these ports to adjust the amount of passage area required. With the restricted area of the steam and exhaust ports, the action of steam in regulating the speed of the air pump engine would be as follows: —

At the beginning of the upward stroke, there is not much resistance, except perhaps the dead weight of the moving parts and a slight mechanical friction of bearings, etc. A very small amouut of steam admitted to the cylinder would start the motion at a certain speed. The initial pressure of steam in the cylinder would be far below the pressure of steam in the slide valve casing. On account of the increasing resistance, due to the compression of air on the bucket, the speed of the bucket falls down little by little; more and more time is given to the steam to get into the cylinder, so as to increase its pressure in proportion to the augumenting resistance. This would prevent a sudden stoppage of the engine, whatever may be the augumentation of the resistance, so long as we have a sufficient margin of reserve pressure in the valve chest. After the crank has passed over the top dead centre, the load on the bucket suddenly disappears. The piston speed instantly increases. But on account of the restricted port area, the steam can not follow the piston with a sufficient rapidity. The pressure of steam in the increasing space at the top end of the cylinder falls dawn. And this would to some extent diminish the jerky motion of the reciprocating parts. The exhaust port plays as important a part as the steam port in the regulation of speed. Let us repeat the cycle of operation and see what is taking place on the exhaust side. At the beginning of the upward stroke, the back pressure on the piston is comparatively high, on accunt of the contracted area of the exhaust port, as well as the rapidly decreasing volume on the top side of the piston. With the increasing resistance the speed of piston falls down little by little. More and more time is given to the exhaust steam to escape and this is attended with the decrease of the back pressure, so the piston is able to continue its motion, in spite of the increasing resistance. After the crank gets over the top dead centre, the load on the bucket suddenly disappears. The piston speed instantly increases. But by reason of restricted area of the exhaust port at the bottom end of the cylinder, the exhaust steam can not escape with sufficient rapidity. This would serve as a splendid cushion to prevent the hammering action of the moving parts upon the main bearings. The restricted port area is not only very beneficial to check the irregularity of the crank motion, during each revolution, caused by the variation of load on the bucket, which is peculiar to the action of the air pump itself, but it is also an excellent governor for the regulation of speed, even when the variation of load is produced by some external circumstances such, for example, as the sudden change in the power of the main engine for which the pump is provided, the pitching and rolling of the vessel, etc. Whatever may be the cause of irregular motion, the office of the restricted area of the steam and exhaust ports is to increase or diminish the forward or back pressure, so as to meet the varying resistance at a right time and in an agreeable manner, and thus make the motion more steady and uniform. Here it may be asked why we could not get at the same result by simply adjusting the openings of the stop valves at the steam and exhaust orifices of the cylinder. The reason is simply this that the volume contained between the piston on which the steam acts and the point at which the steam is wire-drawn should be made as small as possible in order that the effect of the wire-drawn steam on the regulation of the engine speed could be most sensitive. For the same reason, it is a very bad design to have the regulating steam stop valve fitted some distance away from the engine cylinder, using a connecting pipe between them, instead of fitting the valve to the cylinder direct. There is another question: would it not be rather uneconomical of steam to adopt a method in which it has to be wire-drawn.? This is more apparent than real. Since the quantity of steam used per stroke is proportional to the terminal pressure for a given amount of mean pressure, there is no denying the fact that more steam will be required per stroke on this system of regulation than in the case of a steam engine of the same size working in accordance with usual practice of slide valve setting. We must remember, however, that by this means we could run the pump at a slower speed and maintain a better vacuum in the condenser. So that the steam used per unit of time would not be any greater for its adoption. Besides we have another advantage, due to the diminished back pressure on main engine low pressure piston. If the terminal pressure of steam is too high, we can use the exhaust from the air pump engine for some other auxiliary purpose such, for example, as the feed water heater, evaporator, etc.

The Worthington pump, Blake's pump, Weir's pump, etc, known as direct acting pumps have no cranks, their motion being entirely controlled by means of wire-drawn steam. One defect of some of these pumps is that they have no fixed length of stroke. When too much steam is admitted, there is a danger of the piston breaking through the cylinder cover. On the other hand, when the quantity of steam admitted to the cylinder is not sufficient. the piston would stop short of its proper stroke, and commence the return stroke, which action on the part of the bucket would make the clearance space very large and the vacuum in the condenser very poor. Annexed are some of indicator cards taken at different periods from air pump engines on board several vessels of our navy. In the case of the "Naniwa," the air pumps were originally of double ucting type. They were after-ward converted into single acting pumps with a marked improvement in the vacuum. The engine is fitted with Marshal's valve gear, and the motion is being controlled by converting all the four crank arms into solid fly wheels. Those who have witnessed the jerky motion of the "Takao"s' air pumps would understand why it should be so by looking at the card here represented. Air pumps on board the "Matsushima," the "Itsukushima" and the "Hashidate" are worked in combination with the feed, bilge and circulating pumps, so that their motion is considerably better than that of the "Takao's" air pumps. But this system of grouping a number of different pumps and working by one steam engine has this serious defect that when any one pump of the group goes wrong the whole lot would be disabled at the same time. The "Akitsushima" had once had great troubles with her air pumps. The principal cause of the trouble was that the lift of the pump valves was too large. The slide valve setting was not very satisfactory either. Subsequantly they were fitted with new slide valves. And this made the motion smoother. For the sake of comparison, two sets of the indicator cards, one taken before and the other after the alteration are here annexed. In the case of the "Suma," what had been done to the "Akitsushima"s' slide valve was carried a step farther. The top port area was made less than half the area of the bottom steam port, and a considerable amount of negative lead was given to the upper edge of the slide valve. The cruiser "Chitose," built at the Union Iron Works of San Francisco, cal. was fitted with Dow's patent air pumps. They are of a type known as direct acting pumps, there being no cranks nor fly wheels. There is one steam cylinder operating on a pair of single acting vertical pumps, through a working beam. The distributions of steam for the top and bottom ends of the cylinder are exactly alike, each end doing the work for one of the two pumps. Plug cocks are fitted at the top and bottom steam ports to regulate the supply of the steam. The length of stroke is controlled by means of an ingenious governor, arranged in such a manner that the supply of steam to the cylinder would be increased or cut down, according as the throw of the bucket is less than or exceeds the prescribed length of stroke. These air pump engines work very nicely, and could be run as slow as 12 revolutions per minute. A vacuum within one inch of barometric height has often been obtained with these pumps. The air pump engines on board the battleship "Shikishima" are of crank and fly wheel type. They have also given us some trouble in the control of their motion. After trying a modification in the angle of cranks their slide valves were ultimately altered, with a better result. The indicator card here appended was obtained after the new slide valves were fitted. Air pumps, working with blank bucket, without any bucket valve or foot valve, but simply scooping or catching up a certain volume of water and air each stroke seem to be better suited for high speed than the pumps of usual type with the foot and bucket valves. Edward's pump, recently patented in England is one of the best pumps of this description. In concluding this paper the writer should like to thank Admiral Miyabara, Engineer-in-Chief of our navy, who kindly allowed the writer to publish the indicator diagrams and other informations in connection with our air pumps.


NANIWA. H.P.
TAKAO. H.P.
MATSUSHIMA. H.P.
AKITSUSHIMA. ORIGINAL. H.P.
NANIWA. L.P.
TAKAO. L.P.
MATSUSHIMA. L.P.
L.P.
SUMA. H.P.
CHITOSE. STEAM.
SHIKISHIMA.
AKITSUSHIMA. ALTERED. H.P.
SUMA. L.P.
CHITOSE. AIR.
L.P.

驅逐艦ニ就テ

明治三十三年十月二十八日造船協會講演會ニ於テ

近藤基樹

演題ハ驅逐艦ニ就テト云フコトニ致シテアリマスガ、驅逐艦トハ今度日本ノ海軍デ附ケラレタ名デアッテ今日御話ヲ致スノハ英、佛、獨等ニアル此種類ノ船、即英國デハ「デストロイヤー」佛國デハ「アヴィゾ、トルピヤール」獨逸デハ「ヂヴィジョンボート」ナド、申シマシテ、詰リ在來ノ水雷艇ヨリ大キク又巡洋艦ヨリ小サイ一種ノ軍艦デ高速力ヲ持テ居ル船ト云フ意味ヲ以テ御話ヲ致シマス

抑此ノ「デストロイヤー」ノ出來タ起因ヲ申シマスレバ今ヨリ二十年程前ノコトデアッタガ、佛蘭西デハ盛ンニ八十噸百噸位ノ水雷艇ヲ年々數多造ッタ、其目的ハ英國ト戰爭ノ起ッタ時分ニハ海峽ヲ超ヘテ敵ノ軍艦ヲ破壞シ又ハ自分ノ海岸ヲ防禦スル爲デアッテ、暫時ノ間ニ二百艘以上ノ水雷艇ヲ造リマシタ、然ルニ英國ハ之ニ對シテ一々是レダケノ水雷艇ヲ造ッテ防禦スルニハ困難デアルト云フ所カラ、佛國ノ水雷艇ヨリ一層速イ有力ナル船ヲ造ッテ防禦シヤウト云フ考デ或ル種類ノ船ヲ造ッタ、「ラットルスネーク」ノ類デアリマス、即チ日本海軍ノ龍田、千早ナドノ元デアル、併シ是ハモト〱軍艦ヲ基トシテ計畫シタモノデアリマスカラ船體ハ丈夫デスガ肝腎ノ速力ガ水雷艇程ニハ出ナイ、夫故水雷艇ヲ追駈ケ機敏ノ働キヲスルト云フ當初ノ目的ヲ達スルコトガ出來マセヌ、ソコデ速力ヲ増ス爲メニ段々ト船ヲ大キクシテ遂ニ千噸以上ノモノガ出來テ參ッタガ、其内ニハ追々水雷艇ノ製造ガ進歩シテ速力モ一層速クナッテ來テ、夫ヲ捕ヘル方ハ一向進マナイ、夫レデ此種類ノ船ハ通報用トシテ艦隊ニ付ケ其方ノ役務ヲ執ラセルコトニナッタガ到底初ノ目的ハ達セヌニ因テ更ニ計畫ノ方針ヲ替ヘテ、今度ハ水雷艇ヲ基トシテ今ヨリ七年前ニ一艘ノ船ガ出來マシタ、之レガ英吉利ノ「ハボック」ト云フ船デアル、其船ハ今申シタ通リ全ク軍艦組織ヲ止メ水雷艇ノ形チデ船體ヲ大キクシテ速力ヲ増スト云フ方針デ造リマシタ、始メテ出來タ「ハボック」ト云フ船ハ試運轉ノ時ノ排水量ガ二百二十噸、ソレニ速力ガ二十六「ノット」餘デアル、其頃ハ他ノ國ノ水雷艇ハ二十四「ノット」半位ガ最上限デアッタ故二十六「ノット」アレバ大概追駈ケルコトガ出來ル、夫レカラ又船ガ水雷艇ヨリ一體大キイカラ試運轉ノ時分ニハ小サイ船ヨリ少々ハ速力ガ負ケルトモ實際海上ニ出レバ船體ガ大キイカラ波ニモ強ク從テ小船程ニ波ノ爲ニ速力ヲ減スルコトガ少ナイ、夫レデ先ッ濟ンデ居ッタケレドモ他ノ方デモ段々速力ノ早イ船ガ出來テ參ッテ、佛蘭西デハ一時間ニ三十海里ノ速力アル水雷艇ガ出來ルヤウニナッタ、從テ驅逐艇モ大キクナリ速力ヲモ増ス必要ガ起ッテ來タ、初メ二十六「ノット」ノ速力ヲ持ッタ「ハボック」ト云フヤウナ船ガ出來タ頃ハ船體ニ柔カナ鋼鐵ヲ用ヒ汽罐ハ「ロコモーチブ」形デアッタ、所ガ段々船ヲ早ク造ルニハ大キサヲ大キクスルヨ

リ外ハナイ、一體排水量ハ造船家ノ資本ノ樣ナモノダカラ同一ノ材料ヲ用ヒ同樣ノ計畫ヲ採ル限リハ船體機械等ノ重量ニハ凡ソ極リガアル、即チ當リ前ノ式ノ汽機汽罐デハ一馬力ニ付テ何噸トカ船體ノ重量ハ何噸トカ云フコトノ制限ガアル、夫故段々船ヲ大キクシナケレバ速力ハ増サナイ、然ルニ近頃デハ著シク排水量ヲ増サナイデ三十「ノット」マデ出ル驅逐艇ガ出來ルヤウニナッタ、其原因ハ汽罐ノ方ハ水管式ヲ使フコトニナリ從テ重量モ大變輕クナル、船體ノ方ニハ特別ノ鋼鐵ヲ用ヒ普通ノ軟鋼ヨリハ餘程強イ、今各國ノ「デストロイヤー」ノ速力ハ大概三十「ノット」前後デ、近頃又「タービン」式機械ヲ用ヒテ三十五「ノット」以上ノ速力ガ出ルヤウニナッタ、此ノコトハ後ニ申上ケマス、然シテ此ノ上ハ特種ノ發明ノ無イ限リハ船ヲ餘程大キクシナケレバ速力ヲ增スコトハ出來ナイト思ヒマス、夫レデ目今ノ逐驅艦ハ實際水雷艇ト大シタ違ヒハナイ、又其役務ハドウ云フ所ニ用ヒラルヽカト云フト第一ニ「デストロイヤー」トシテ即チ敵ノ水雷艇ヲ打壞ハストカ或ハ捕獲スルト云フコト、第二ニハ艦隊ト根據地トノ間ノ通信トカ、各艦ノ間ノ通信トカ又ハ偵察トカ、サウ云フコトニ用ヒラレル、船ガ軍艦ヨリ小サイカラ敵ニ見ラルヽコトガ遲イノデ偵察ニハ最モ適當デ縱令見ラレテモ速力ガアルカラ敵ノ追擊ニ遇ッテモ容易ニ逝テ歸ッテ來ラレル、夫カラ獨逸ノ海軍デ遣テ居ル通リ「ヂヴィジョンボート」トシテモ用ヒラレル、英國ノ海軍デハ「デストロイヤー」ト云フノガ公ノ名ニナッテ居リマスガ實際役務ハ二ツアル、「デストロイヤー」トシテ用フルトキハ敵ノ水雷艇ニ向テ働クノデ發射管ヲ卸シテ大砲バカリ載セテ追駈ケル、又或ル場合ニハ水雷艇トシテ使フ、其時分ニハ大砲ノ一部ヲ卸シテ遣ル、勿論地中海艦隊支那艦隊ノ如キ遠方ノ役務ニ就テ居ルトキハ兩方載セテ居リマスガ本國デ使ッテ居ルノハ根據地又ハ母艦ガ近イカラ片一方ニナッテ居ル、勿論練習ノ爲メニハ兩方載セテアリマスガ實際ノ役務ニハ必要ニ應シ或ハ水雷驅逐艇トシテ使ヒ或ハ水雷艇トシテ使フト云フコトヲ聞テ居リマス、ソコデ驅逐艦ハ英國ニ百艘、他ノ國デモ二十艘三十艘ト云フヤウデアリマスガ、皆大同小異デアリマスカラ一ツノ例ヲ取テ御話ヲ致シマセウ

此第一圖ハ英國ノ「アングラア」ノ種類ノ船ノ積リデ、第一圖ガ内部デ第二圖ガ外部デアル、此船ハ長サガ二百十呎アッテ幅ガ十九呎半、喫水ガ五呎八吋デ二百八十三噸ノ排水量デアル、是レハ試運轉ノ場合デアル、所ガ實際ノ役務ニ就クト排水量モ餘程殖エル、玆ニ大體ノ重量表ガアリマスガ一々御話ハ致シマセヌ表ニ就テ御覽下サレタイ、夫レデ此船ハきやしやナ造リデアリマシテ二百八十三噸ノ船デスガ船體附屬品ノ重サハ百二十五噸シカナイ、ダカラ他ノ船カラ見ルト餘程輕クナッテ居ル、夫レカラ「スカントリング」ハ商船ヨリ考ヘルト驚クホドきやしやデアル、假令バ「フレーム、アングル」ハ中央部デ二吋半、一吋四分ノ三厚サ八分ノ一吋前後デハ一吋四分ノ三、一吋半八分ノ一ト

云フヤウニナッテ居ル、其他ハ夫レニ準シテ薄イモノデアル、外板ハ極ク厚イ所デ四分ノ一吋、前後ハ八分ノ一吋以下デアリマスガ波ニ乗ッテノ強ミハ充分アリ隨分風波ニハ能ク堪ヘマス、又此通リノきやしやナ造リデスカラ總テ局部ノ弱イノガ却テ全體ノ強ミデアリマス、ト申スハ他ノ物ニ衝突ナドシタ場合ニ局部丈ケガ潰レルノデ全體ニ故障ヲ及ホスコトヲ免カレルノデ此點ハ内外國デ既ニ充分經驗ノアルコトデアリマス

夫レカラ兵器ハ十二斤速射砲一門六斤速射砲五門總テ六門デ、又水雷發射管ハ近頃ノ船ニハ二個アリマシテ孰レモ旋回管ニナッテ居リマス、此位ナ小サイ船デハ海ノ上デ水雷ヲ倉庫ヨリ取出シ發射管ニ裝塡スルノハ非常ニ困難デモアリ、又調整ノ工合モ充分精確ニ行カナイト云フノデ英國其他デモ大概豫備ノ水雷ノ設ケハアリマセヌ、抑モ「ハボック」デハ艇首ニ固定管ガアリマシタガ竣工ノ上發射試驗ヲ施行シタトキニ艇ノ速力ガ速イ爲メ發射シタ水雷ヲ乗越シタコトガアルノデ其後ノ艇ニハ艇首ノ發射管ヲ廢シタノデアリマス

機械ノコトニ付テハ夫々專門ノ諸君ガヰリマスカラ別段申シマセヌガ、唯震動ヲ防クト云フコトニ付テ各製造者ハ種々工風ヲシテ研究シテ居ルト云フ丈ケ申上ゲマス、假令バ「ソーニクロフト」會社デハ「シリンダー」ヲ斜メニシテ兩「クランク」ノ角ヲ略ホ一直線ニシテ置テ力ヲ平均サスルヤウニシテ震動ヲ減ズルコトニ努メテ居ル、又「ヤルロー」會社ナドデハ「カウンター、ウェイト」ヲ用ヒ力ノ平均ヲ計ルナド夫々工風ヲ凝ラシテ居リマス

又復原力ノ點デハ先ツ「メタセントリック、ハイト」ガ二呎半位ガ平均デアリマシテ（第四圖參照）復原力ハ九十度以上アリマス、即第五圖ニ示ス樣ナ曲線デアリマス、然シ斯ノ如キ小サイ船デスカラ海上デノ動搖ハ中々強イ、搖程（ピリオド）ハ甚タ短ク二秒乃至三秒デ私モ英國海峽デ多少風波ノアルトキ乗ッテ見マシタガ橫波デハ三十度以上ノ傾斜ハ珍ラシクアリマセヌ、併シ防水ガ充分ニ出來マスカラ千噸位ノ砲艦ヨリハ却テ安全ニ思ハレマス

夫レカラ此種類ノ船ハ特色ガ速力デアリ試運轉ノ方法ガ普通ノ船トハ多少異ナルコトガアリマスカラ試運轉ノ仕方ニ付テ一ト通リ御話ヲシマセウ

先船ガ出來上ッテ試運轉ヲスルコトニナルト、造船所ト試運轉ノ場所ト距離ガ遠イ所ナラ先一度準備試運轉ヲスル、其時ニ石炭ノ消費ヲ測リマシテ試運轉ノ場所ヘ行クマデニ凡ドノ位ノ石炭ガ要ルカヲ見テ夫丈ケ規定ノ重量ヨリ餘分ノ石炭ヲ積ンデ出カケル、英國デハ全速力繼續運轉ノ時間ハ三時間デ其内先ツ六回ダケ一浬ノ標柱間ヲ駛リ其回轉數ヨリ一浬駛走ニ要スル回轉數ヲ測リマス、此時間ガ凡ソ一時間カヽル其間ニハ回轉ニ餘程時ヲ費シマスガ其間ハ自然回轉數ガ減ズル、然シ直線ニ走レバ矢張標柱間ト同樣ノモノト見做シテソコデ最初一時

間ノ速力ハ標柱間六回駛走ノ平均速力ト同一ト見做ス、夫レヨリ尚ホ二時間ハ全速力デ成ルベク直線ニ走リ其二時間ノ總回轉數ヲ標柱間駛走ノトキ得タル一浬ニ要スル回轉數デ除スレバ二時間ノ駛走距離ガ出ル、之レニ標柱間ノ平均速力ヲ加ヘ三デ除シタモノヲ此船ノ三時間平均ノ速力ト稱スルモノデアリマス、茲ニ試運轉成績表ノ一例ヲ掲ゲテ置キマシタカラ之デ能ク御分リニナリマセウ

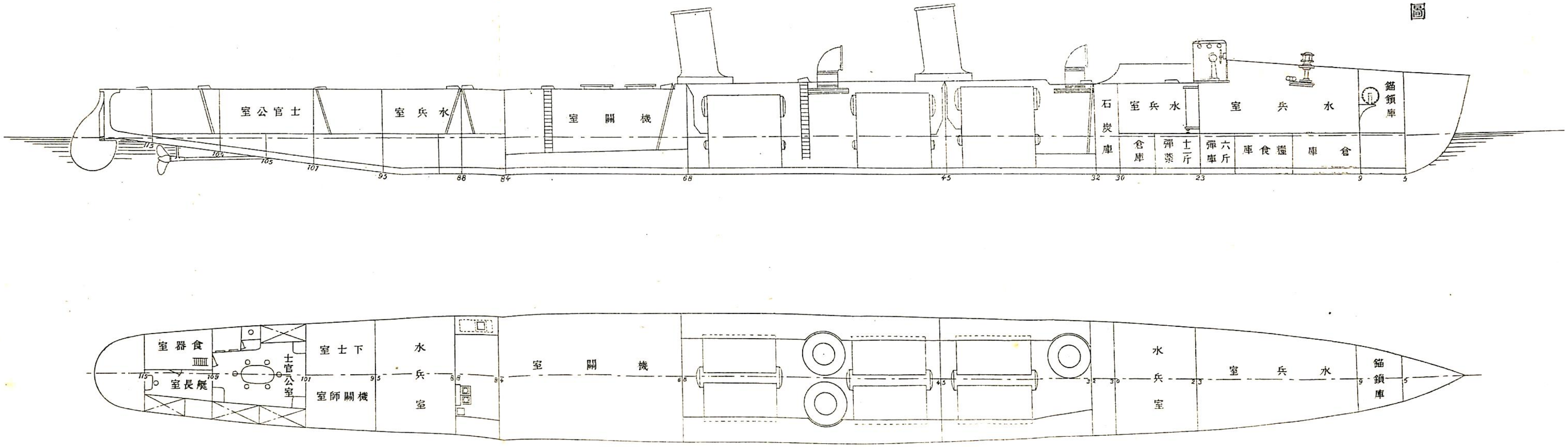
夫レカラ今度ハ石炭ノ消費デアリマスガ、是ハマダ充分經驗ガアリマセヌカラ申上ゲマセヌ、夫レカラ船卸ノコトモ序ニ鳥渡申上ゲマスガ之ハ通常ノ船ト格別違ヒハ無イ、茲ニ「ヤルロー」ノ會社デ造ツタ船ノ進水裝置ノ大體ノ圖ヲ持テ來テ居リマスガ(第六圖)船臺ノ傾キハ一呎ニ付八分ノ三デアルガ卸臺ハ一呎ニ付テ一吋八分ノ七デアル、常ノ船カラ思フト著シイ傾斜ノ樣ニ見ヘルガ船體ガ輕イノデ此位傾キガ無イト卸リニクイノデス、又「キール」ノ傾キヲ少ナクシタノハ水ニ浮ンダトキ矢張略同樣ノ傾キデ居ル樣ニシテアル、左モナイト卸臺前部ノ壓力ガ強クナツテ「シヤフト」ノ線ニ狂ヒガ出ル樣ナ恐レガアル

先刻鳥渡申上ケタ通リ近年ニナツテパーソンノ發明シタ「スチームタービン」ヲ驅逐艦ニ用ヒテ試驗中デアルガ、英國海軍デモ二艘造ツテ居ル其内一艘ハ過日試運轉ノトキニ三十六「ノット」以上出テ居ルコトハ諸君モ御承知デアラウト思ヒマスガ、先ニモ申上ゲタ通リ尋常ノ機械デハ速力ノ最上限ニ近ヅイテ居ルカト思ヒマス、ソコデ唯今マデヨリ以上ノ速力ヲ得ルニハ「スチームタービン」ノ如キハ將來大ニ見込ノアルコト、考ヘマス

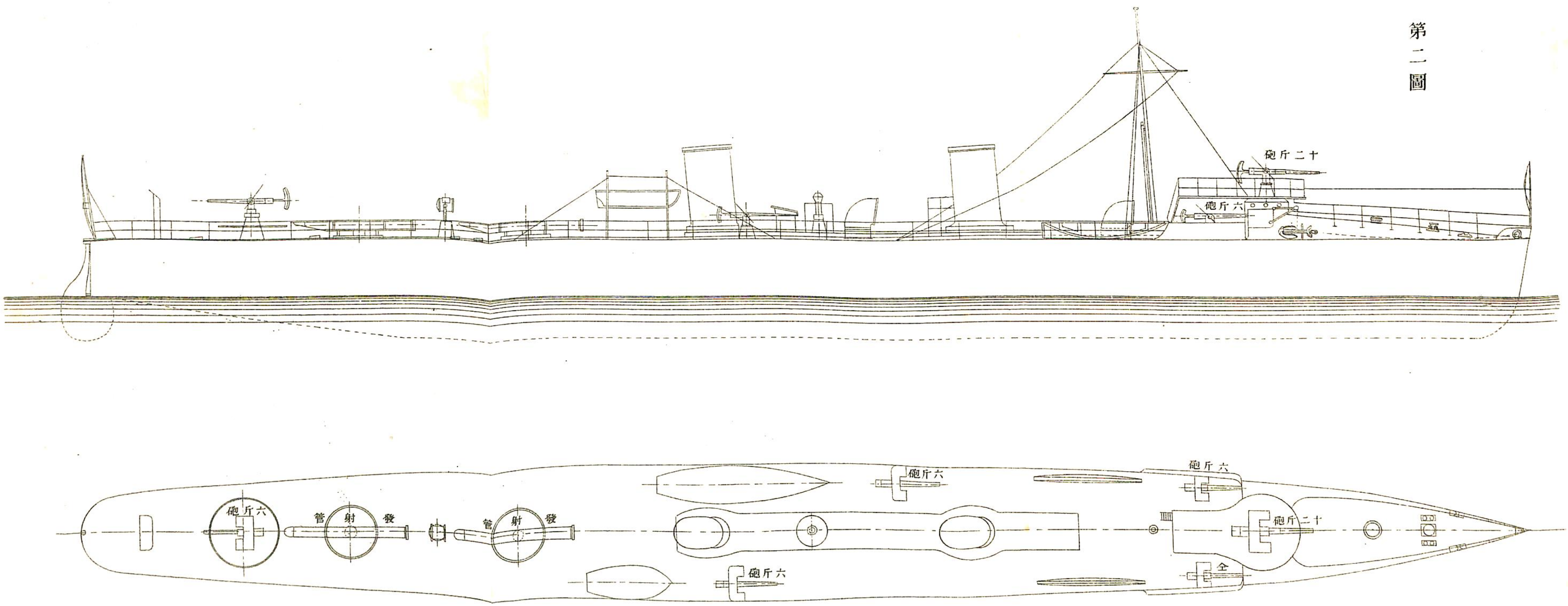
詰リ驅逐艦ト云フモノハ唯今マデ申上ケタ通リ大キサノ外ハ略ホ水雷艇ト同ジコトデアル、尤モ偵察トシテ艦隊ニ付テ行クニハ波ニ堪ヘル力ガ要ルカラ自然大キク無クテハナリマセヌガ其他ノ役務ニハ餘リ大キク成リ過ギハセヌカト云フ考ガアル、或ハ同シ入費デ水雷艇ヲ數多ク造ツタ方ガ利益ナ點モアルカト思フノデス

マダ後ニモ段々講演ヲナサル人モアリマスカラ此位デ御免ヲ蒙リマス

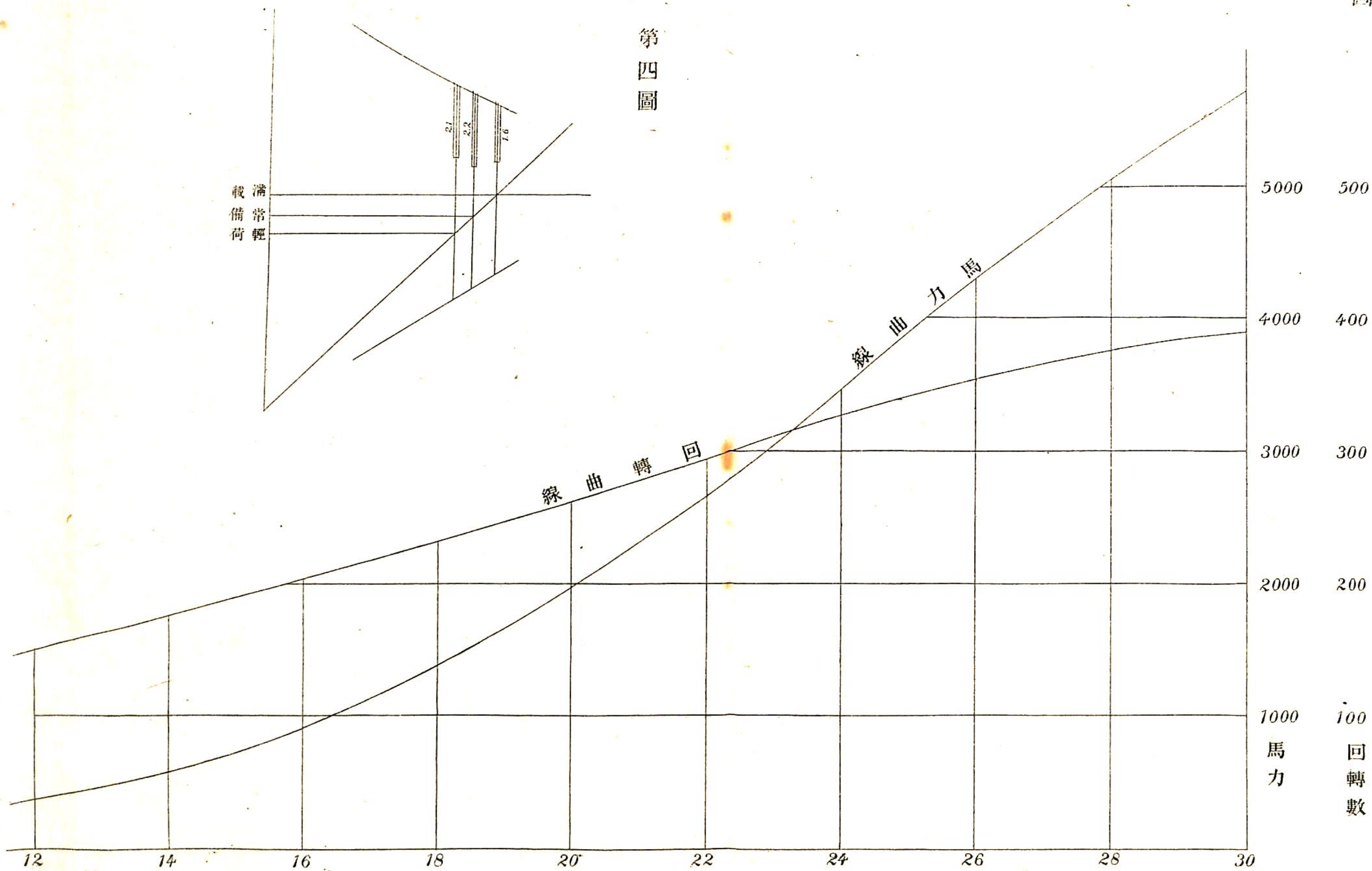
第一圖


士官公室
水兵室
機關室
石炭庫
水兵室
水兵室
錨鎖庫
倉庫
十二斤彈薬
六斤彈庫
糧食庫
倉庫
115
105
101
93
88
84
68
45
32
30
23
9
5
食器室
艦長室
士官公室
下士室
機關師室
水兵室
機關室
水兵室
水兵室
錨鎖庫

第二圖

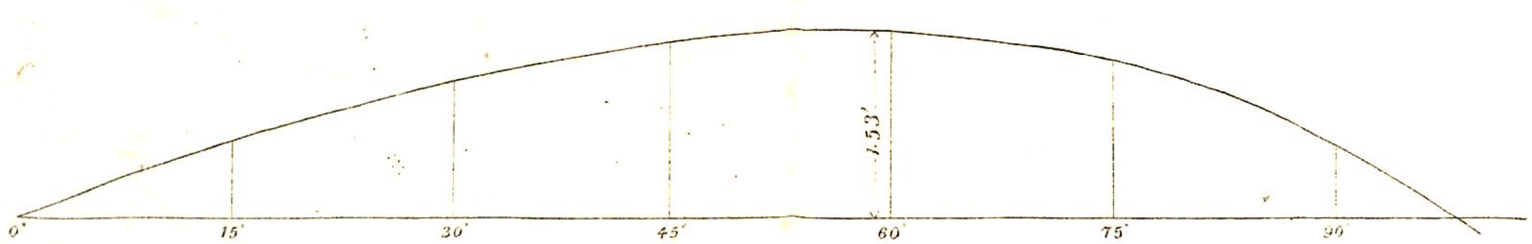

十二斤砲
六斤砲
六斤砲
發射管
發射管
六斤砲
六斤砲
十二斤砲
全
六斤砲

第三圖



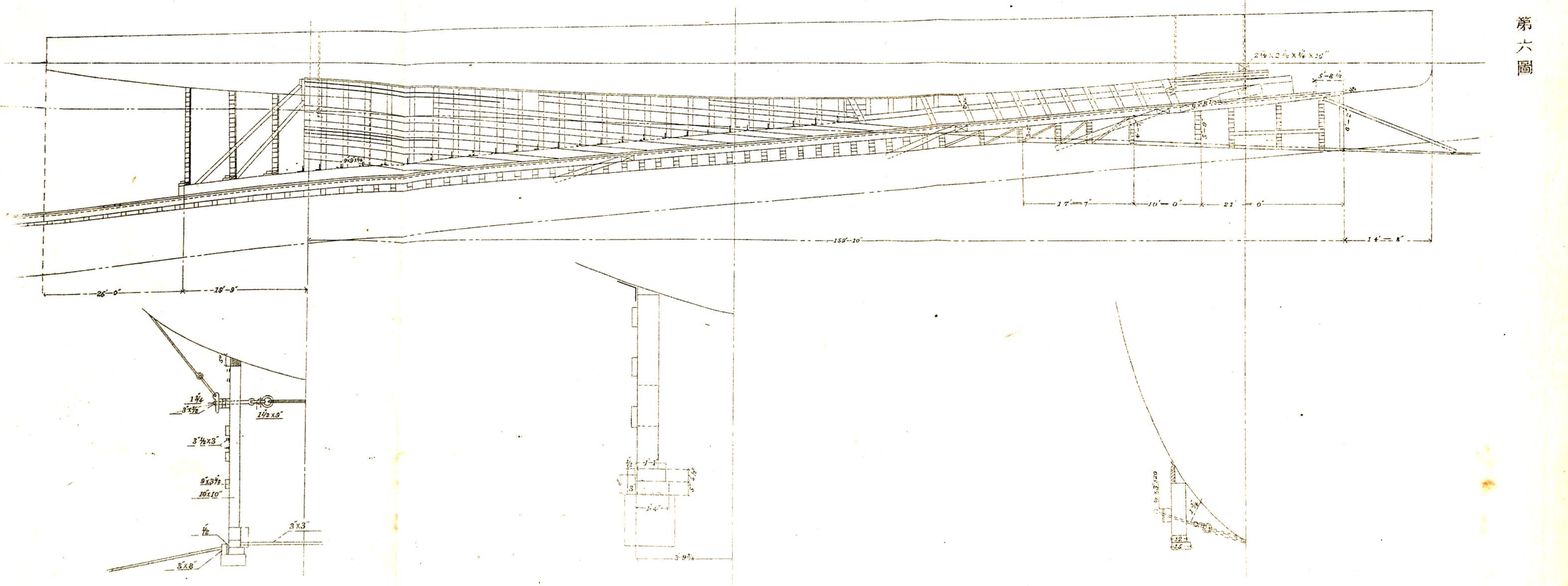
回轉曲線
馬力曲線
5000 500
4000 400
3000 300
2000 200
1000 100
馬力
回轉數
12 14 16 18 20 22 24 26 28 30
第四圖
滿載
常備
輕荷
21
22
16

第五圖



1.53'
0° 15° 30° 45° 60° 75° 90°

第六圖


25'-0"
19'-9"
159'-10"
17'-7"
10'-0"
21'-0"
14'-8"
5'-8 1/2
1 3/4
1 1/2 x 9"
3"1/2x3"
10"x10"
3"x3"
5"x8"
3'-9 3/4

重　量　表

STATEMENT OF WEIGHTS.

	Normal	Trial
Water	3.12	35.00 Load
Officers, Men & Effects	5.50	
Provision	2.70	
Masts & Rigging	.38	.38
Anchors	.84	.84
Stores	4.40	
Cables & Accessories	2.13	2.13
Boats	2.00	2.00
Armament and Ammunition	16.91	
Machinery	125.00	125.00
Hull & Fittings	112.50	112.50
Coal	40.00	
	335.48	277.85

公 試 運 轉 成 績 表

	PRESSURE IN RECEIVERS						Vacuum		Air Pressure		REVOLUTIONS				Observed Time	Speed due to Time	1st Mean	2nd Mean
	HP		IP		LP						PER MILE		PER MINUTE					
	S	P	S	P	S	P	S	P	S	P	S	P	S	P	m s			
1	195	200	105	100	27	26	26	28	$3\frac{1}{2}$	3	736	724	392.9	386.4	1–52.4	32.028	30.530	
2	197	200	105	100	27	28	26	27	4	3	804	799	388.4	385.3	2– 4.2	29.032	30.554	30.542
3	195	197	104	100	28	30	26	27	4	3	734	723	392.5	386.6	1–52.2	32.085	30.466	30.510
4	198	203	102	98	27	29	26	28	$3\frac{1}{2}$	$3\frac{1}{2}$	806	802	387.7	385.9	2– 4.8	28.846	30.130	30.298
5	193	196	102	100	27	29	$26\frac{1}{2}$	26	3	3	728	720	381.1	380.4	1–54.6	31.414	29.948	30.039
6	184	184	100	96	26	26	$25\frac{1}{2}$	26	3	$2\frac{1}{2}$	800	799	378.5	378.0	2– 6.4	28.481		
Mean	192	193	103	99	27	28	26	27	$3\frac{1}{2}$	3	764	760	385.5	383.8		Mean		30.350
											PER 20 MINUTES							
1	200	205	110	110	30	30	26	26	4	$3\frac{1}{2}$	7900	7840						
2	200	210	115	110	30	30	26	$25\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{1}{2}$	7860	7732						
3	205	205	115	110	32	28	26	25	4	3	7894	7804						
4	200	205	110	108	31	31	26	25	4	$3\frac{1}{2}$	7906	7786						
5	200	205	105	105	30	31	25	$24\frac{1}{2}$	4	3	7836	7754						
6	195	200	105	105	30	30	24	24	$3\frac{3}{4}$	3	7822	7738						
Mean	200	200	110	108	$30\frac{1}{2}$	30	$25\frac{1}{2}$	25	4	$3\frac{1}{4}$								

Total 47218 46654

46654

2|93872

$\frac{46936}{762} = 61.596$

61.596

30.350

3|91.946

30.649 Mean of 3 hours

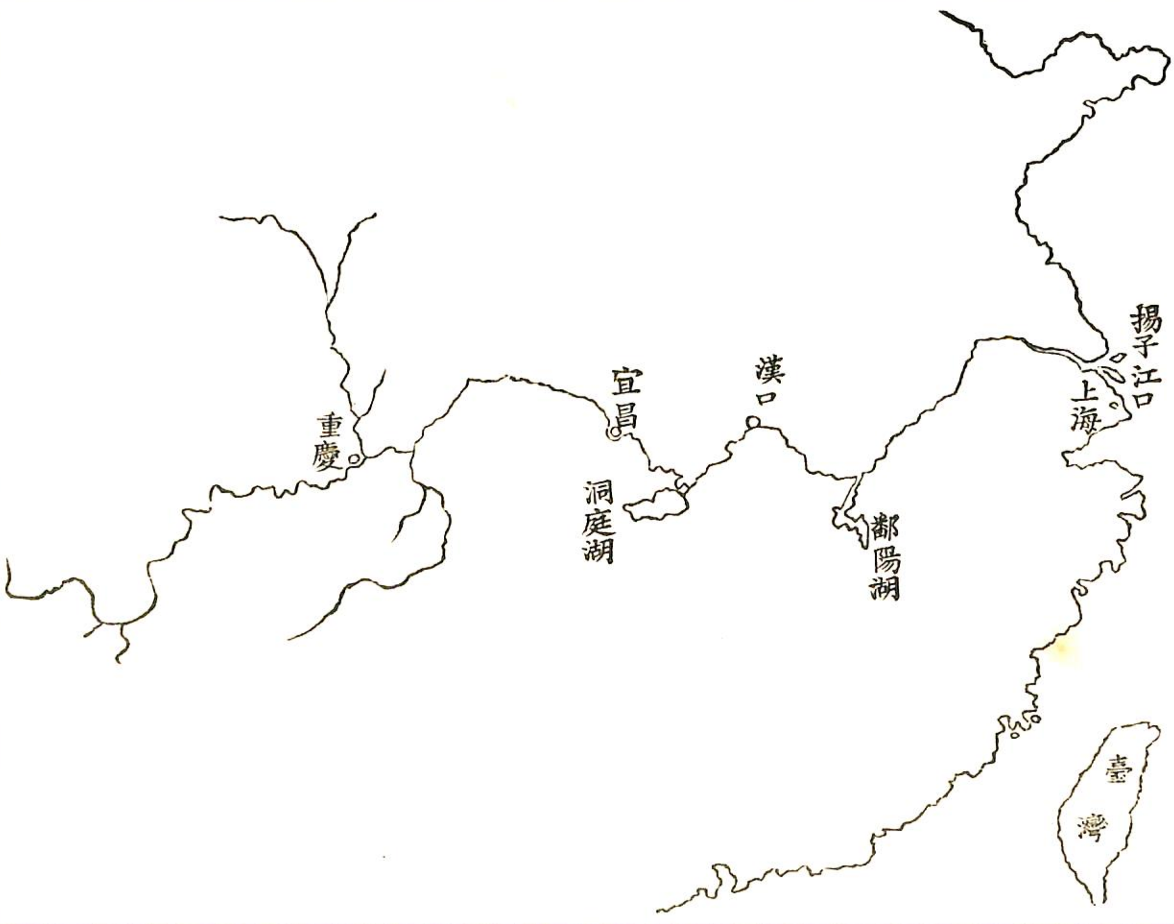
楊子江航行輕喫水船

明治三十三年十月二十八日造船協會講演會ニ於テ

小西愼三郎

私ガ今日御話シマスノハ支那ノ楊子江ニ喫水ノ極ク淺イ船ガ、澤山航海シテ居リマスガ其船ニ就テ調ベタコトガゴザイマス、又此航路ニ向ツテ四艘ノ船ヲ計畫イタシタコトガゴザイマスカラ其事ニ付テ御話ヲ致サウト思ヒマス、其船ニ就テ御話シマスニハ概畧川ノ御話ヲ致スノガ必要カト思ヒマスカラ雜ット申上ゲマス

此楊子江ト云フ川ハ御承知ノ通リ世界ノ中デモ屈指ノ大キナ川デゴザイマス、之ヲ測量シタ人ハ無イケレドモ、歐米各國ノ人ガ探撿シタ其踏査ノ結果ハ此川口カラ川上マデハ三千海里乃至三千五百海里ノ間デアルト言ッテ居ル位ノ大キナ川デアリマス、此川ハ夏ノ間ハ大變深イガ其反對ニ冬ニナルト大變淺クナリマス、夏ノ間ハ上海附近ノ川口カラ漢口マデ六百八十海里ホド川上マデハ通常ノ海ヲ航行スル三千噸乃至四千噸ノ喫水ノ深イ船ガ自由ニ行クコトガ出來ルノデアリマス、ソレガ冬ニナルトスッカリ淺クナッテドウシテモ特別ニ喫水ノ淺イ船デナケレバ航行ガ出來ナイノデアリマス、ソレデ此川ノ中デ本年マデハ此上海カラ一千五拾海里ホド川上ニアル宜昌マデハ汽船ガ航通シテ商賣ヲシテ居リマシタ、此宜昌ト漢口トノ間ガ三百七十海里、漢口ト上海ノ間ガ八百六十海里デアル、宜昌漢口間ハ上海漢口ト違ッテ此間ハ特



別ニ淺イ船デ航海シテ居リマスガ、當年カラ宜昌ト重慶トノ四百四十海里ノ間ニ一艘ノ船デ航通ヲ開イタ人ガアリマス、當時此航路ニ航行シテ居ル船ハ隨分多數デゴザイマス、ソレハ表ニシテアリマスカラ皆サンニ御覽ニ入レマセウ、此表ニ據リマスト御覽ノ通リニ上海ト漢口ノ間ヲ航海シテ居ル汽船會社ハ九ツゴザイマス、ソレカラ又漢口ト宜昌ノ間ヲ航海シテ居ル會社ハ六ツアリマス、ソレデ此上海漢口間ヲ航海シテ居ル會社ノ一ツハ招商局デアル、此會社ノ持ツテ居ル船ハ此表ニアル如ク江裕、江孚、江通、江寛ト云フ船デアリマス、此中デ一番大キイノガ江裕デ總噸數三千九十八噸デアル、江孚ハ二千三百噸、江通ハ千六百四十噸、江寛ハ千六百十一噸デゴザイマス、其製造年月又ハ製造人等ハ此表ニ書イテゴザイマス、其他又印度支那蒸氣航通會社ト云フノガゴザイマス、此會社ノ船モ表ニアル如ク二千五百四十噸、二千六百六十五噸、二千六百七十二噸ノ三艘デアル、又支那航通會社ト云フノガアリマス、是レハ二千七百三十二噸、二千五百四十八噸、二千五百噸ノ三艘デアル、是等ノ製造人ハ皆相當ナ者デグラスゴー、グリノック、ノ「スコット」グラスゴーノ「イングリス」、グラスゴーノ「ロンドン、アンド、グラスゴー」會社ト云フヤウナ人ガ拵ヘタ船デゴザイマス、又上海デ拵ヘタ船モゴザイマス、ソレカラ大阪商船株式會社ノ船デ當時此航路ニ航海シテ居ル船ハ大亨、大利ト云フノデアリマス、其外獨逸ノ「アーノルドカーウエル」會社ノ船デ瑞安、瑞泰ト云フ船ガアリマス、又「メルチヤース」ト云フ獨逸人ノ會社デ美利、美福ト云フ船ガアリマス、ソレカラ支那人一個デヤツテ居ル瓊港ト云フ船ガアリマス

ソレデ上海漢口間ハ斯ノ如ニシテ漢口宜昌間ヲ通ツテ居ルノハ「チヤイナナビゲーションコンパニー」支那航通會社ノ沙市、固陵、洞庭ト云フ船デアリマス、又大阪商船株式會社ノ大元丸ト今一艘ハ當時大阪ノ鐵工場ニ於テ製造中デアルガ落成ノ上ハ此航路ニ使ウノデアリマス、又漢口、宜昌間ノ航海ヲサセル目的ヲ以テ「アーノルドカーウエル」會社ガ獨逸ニ於テ一艘拵ヘテ居ルト云フコトヲ聞キマシタ、又近頃モウ一艘「メルチヤース」會社デモ獨逸デ拵ヘテ當時上海ヘ回航中ト聞キマシタガ、最早著シテ航海ヲシテ居ルカモ知レマセヌ、ソレカラ又招商局デハ快利ト云フ船ヲ持ツテ居ル、又印度支那蒸氣航通會社デハ昌和ト云フ船ヲ持ツテ居リマス、先ヅ是レダケノ船ガ當時此楊子江ノ川ノ中ヲ航海シテ居リ、又此航路ニ向ツテ製造サレテ居リマス、ソレカラ此外ニ宜昌ト重慶ノ間ニ本年ノ夏カラ英國人ガ集ツテ會社ヲ拵ヘテ一艘ノ船ヲ造ツテ航海ヲ始メマシタ、此船ハ英國ノクライドニ近イダンバートンノ「デニー」ト云フ造船所デ拵ヘタ船デ其噸數ハ確ニ分リマセヌガ、船ノ長サ(垂線間)ハ百八十尺、最大幅ガ三十尺、深サハ十二尺、速力ハ十四海里、ソレデ推進機ハ外車デゴザイマス、機械ノ寸法其他ハ分リマセヌガ船名ハ「パイチニヤ」ト聞キマシタ

是レホド色々ノ船ガ航海シテ居リマスガ、此船ノ構造其他ニ付テ御話ヲ致スニハ私ガ曾テ大阪商船株式會社ニ居ッテ計畫シマシタ船ガ四艘ゴザイマスカラ其計畫ノ順序ヲ御話スルノガ便利ト思ヒマスカラ其方デ委シク構造ヤ何カヲ申上ゲヤウト思ヒマス、ソレデ丁度明治三十一年ノ夏デゴザイマシタガ大阪商船株式會社デ楊子江ニ向ッテ二艘ノ船ヲ新造シヤウト云フコトニ決リマシテ其船ノ計畫ヲ私ガ命ゼラレマシタ、此二艘ノ船ヲ計畫シマスニハ先ヅ第一ニ船ノ程度ハドノ位ニスルカヲ決メネバナラヌ、其目的ヲ決メル爲ニ會社ノ中橋社長ト商議ヲ致シマシテ三ツ重モナル目的ヲ定メタノデゴザイマス、第一ハ今度新ニ拵ヘル船ハ楊子江ノ上海ト漢口ノ間ニ使ウ船デアルカラ喫水ハ冬ノ淺キ時モ夏ノ深キ時モ一向差觸リナク十分航通セナバナラヌノガ一ツノ目的デアル、ソレカラ第二ハ只今御覽ニ入レタ表ノ如ク上海漢口間ニハ澤山ノ汽船ガ航通シテ居ルカラ商船會社ノ船ガ行ッタラ是等ノ船ト商賣上競爭ガアルニ相違ナイ、其際ニ是等ノ船ノ中デ速力ノ早イ船ヨリ速力ガ劣ッテハナラヌト云フノガ第二ノ目的デアル、ソレカラ第三ハ此航路ハ乘客ノ收入ヲ以テ經濟ヲ立テルカ、又貨物ノ運賃ノ收入ヲ以テ經濟ヲ立テルカト云フニ乘客ノ運賃ト貨物ノ運賃ト雙方ヲ以テ經濟ヲ立テネバナラヌ航路デアルト云フコトニ目的ヲ決メマシタ、又モウ一ツハ船ノ大キサハ總噸數二千噸少シ餘ニセネバナラヌト云フ此四ツノ目的ヲ最初ニ決メタノデゴザイマス、之ニ據リマシテ船ノ計畫ヲ致シマシタ、ソレデ此目的ヲ達シマスニハ十分ニ此川ノ深サト各會社ノ船ノ速力其他ニ調査ヲセナバナラヌコトガ澤山ゴザイマスカラ是等ノ爲ニ人ヲ出シテ貰ッテ調査イタシマシタ、其結果斯ウ云フコトヲ得タノデゴザイマス、第一ニ喫水ノコトヲ決メルニハ川ノ深サヲ知ルノガ必要デアルカラ夫等ノ報告ヲ集メマシタ、所ガ此川ハ一月二月ノ頃ガ一番淺ク、ソレカラ次第ニ深クナッテ七八月ノ頃ガ最モ深イノデゴザイマス、其深サノ差ハドノ位カト云フト、冬ノ一番淺イ時ト夏ノ一番深イ時トノ差ハ其場所ニ依ッテ色々差ガゴザイマスガ、此漢口ト云フ所ハ四十尺カラ五十尺ホド深サガ違フ、ソレカラ又宜昌ニナリマスト六十尺位ノ差ガアリマス、一番冬ノ淺イ時ニソレ等ノ部分ノ深サハドノ位カト云フト、年々多少ノ差ハアリマスガ平均ノ深サハ上海漢口間ハ最モ淺イ時ハ十尺内外デアル、漢口宜昌間ハ三ツノ水路ノ中デ一番惡イ所デアリマスガ、ソレガ六尺内外ノ深サデアル、夫カラ宜昌重慶間ハ七尺内外ノ深サデアルト云フ詳細ノ調査ヲ得マシタ、ソレカラ各汽船會社ノ速力ニ付テ色々調ベマシタガ、日本人ガ楊子江ノ航路ニ出テ競爭スルト云フ評判ガ立チマシタカラ調査ニ困難ヲ致シマシテドノ船ハドノ位ノ速力ガアルト云フコトヲ確實ニ調ベ得ナカッタ、ソレデ只評判ヲ聽取ッタ報告ヲ集メマシタ、其評判ニ付テ見マスルト此表ニアル所ノ上海漢口間ニ在ル極ク早イ船ハ速力ガ十四海里乃至十五海里デアルト云フ評判ヲ聞キマシタ、ソレデ其機械寸法、又ハ其船ノ

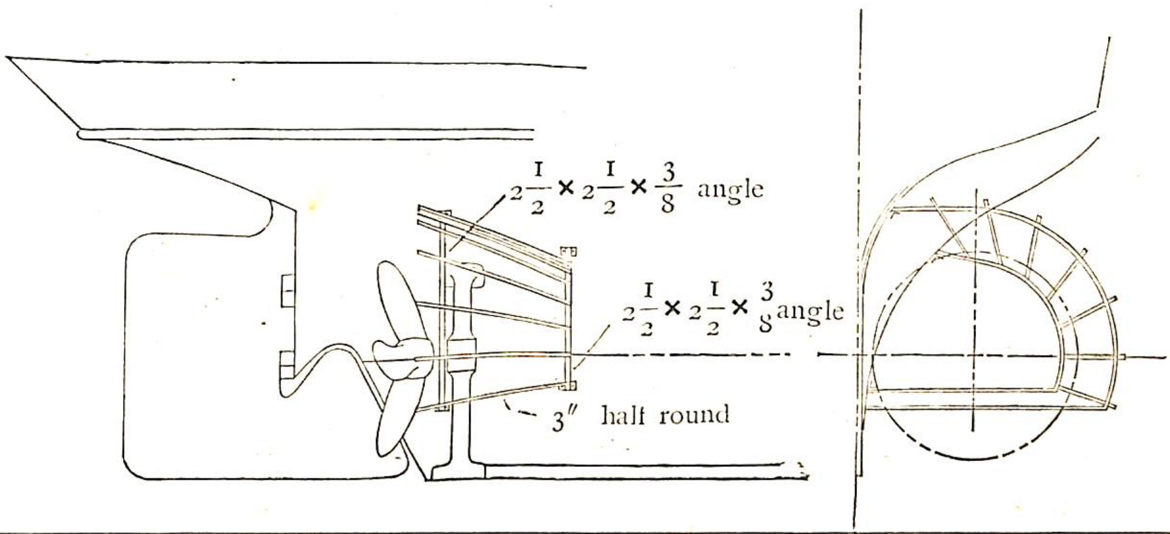
噸數、夫カラ「ロイド」船名錄ニ依リ船ノ長サ幅深サ等ヲ調ベマシタガ、夫等ニ據ッテ推測ヲ下シマスト餘程ムヅカシイコト、私ハ考ヘマシタ、夫カラ又此航路ハ客ヲ積ムバカリデ經濟ガ立ツカト云フトサウデナイ、又荷物バカリデ宜イカト云フトサウデモナイ、即チ客ト荷物トノ收入ヲ以テ經濟ヲ立テルノデアル、サウシテ見ルト船ハ貨物モ多數ニ積ムコトガ出來又客室モ充分ニ廣キ船ヲ持ッテ行カネバ商賣ガ出來ナイ、故ニ十四海里乃至十五海里ノ報告ハアレハ間違ヒデハナイカト云フ考ヘヲ起シマシテ到頭此速力ニ付テハ確實ナ調査ヲ得ルコトガ出來ナカッタ、又乘客ト貨物ハ此船ノ計畫上ニ大ナル關係ガアリマスカラシテ是等ニ付テモ報告ヲ集メマシタ、所カ此水路ニ付テノ乘客ハ上等客ハ極少數ノ歐羅巴人ト日本人デアル、夫カラ其ノ次ニハ支那人ノ官吏ノ往復、其次ニハ支那商人ノ往復、其次ニハ極ク下等ナ勞働者ノ往復ガ澤山アル、夫カラ貨物ハドンナモノカト云フト、此水路ニ往復シテ居ル貨物ハ極ク輕イ荷ガ多イ、其種類ハドウカト云フト、第一ガ茶デアル、ソレカラ綿、綿絲、綿布、石油、食糧「マッチ」其他日常ノ必要品ト云フヤウナ極ク輕イ荷物ガ多ク、此水路ニハ重イ荷物ハ極テ少ナイ、是レダケノ材料ヲ集メマシテ三十一年ノ夏カラ船ノ計畫ニ著手致シマシタ、其船ハ斯ウ云フ寸法ニ致シマシタ、垂線間ノ長サヲ二百七十尺、最大幅ヲ四十尺、ソレカラ龍骨ノ上面ヨリ重甲板ノ上面マデ十二尺六吋、重甲板ノ上面ヨリ「プロメナードデッキ」ノ上面マデ七尺七吋、「プロメナードデッキ」ノ上面ヨリ「セイドデッキ」ノ上面マデ七尺、ソレカラ總噸數凡ソ二千二百噸、載貨喫水平均九尺トシテ石炭ヤ飲料水ヲ除キマシテ「デッドウエイト、キヤパシチー」ヲ五百八十噸ニ致シマシテ汽機ハ三聯成ノ汽機ニシテ推進機ハ雙暗車デ汽機ノ寸法ハ高壓ヲ十六吋、中壓ヲ二十五吋、低壓ヲ四十三吋、行長ヲ三十吋、ソレカラ「コンデンサー」ノ冷汽總面積ガ二千七百平方尺、汽罐ノ壓力ガ百八十磅、汽罐ノ數ハ二個デ通常ノ「ダブルエンデッドボイラー」デアル、ソレデ汽罐ノ直徑ハ「ダイアメター」則チ直徑ガ十二尺、長サガ十五尺六吋、受熱面積ガ四千五百平方尺、夫カラ火床面積ガ百四十三平方尺、ソレデ速力ハ九尺滿載ノ喫水デ十二海里ノ速力ヲ出スコトニ計畫イタシタノデゴザイマス、ソレデ是レハ圖面ニ據リマセヌト御話ガ仕惡イカラ圖面ヲ皆サンニ御目ニ懸ケマス、ソレカラ船體ノ構造ハ中央截斷圖ニアリマスガ、成ルベク喫水ヲ淺クシテ出來ルダケ輕クスル目的ヲ以テ計畫イタシマシタ、此圖面ニ少シ不明ナ所ガゴザイマスカラ或ハ御分リニナラヌカモ知レマセヌガ、此「メインデッキ」ノ下ニハ中央ニ「ロンジチユージナルバルクヘッド」則チ縱通支水壁ガ船首カラ船尾マデ通ッテ居リマス、此構造ヲ御覽ニナルトマダ輕減スル餘地ガアラウト云フ御考ヘモアリマセウガ、私モ斯ノ如キ水路ノ船ヲ計畫シタコトハ經驗モ淺イコトデ多少臆病ノ點モゴザイマシタ、ソレニ商賣ノ船ハ軍艦ト違ヒマシテ至ッテ手入レガ惡イモノデアリマスカラ保

存ノ爲ニ幾ラカ丈夫ニセネバナラヌ所ガゴザイマス、ソレカラ又少シ船ガ弱クシテ震動ナドガアルト乘客ガ非常ニ怖ガッテアノ船ハ震動ガアッテ非常ニ惡イ船デアルト云フコトヲ言ハレマスカラ諸君ガ御覽ニナッタラ少シ丈夫過ギハセヌカト云フ御考ヘモアリマセウ、ソレデ第一著ニ計畫シタノハ此中央截斷圖ノ通リノ構造デ計畫シタノデゴザイマス、此計畫ニ付キマシテハ此圖面ヲ調製シ、又船體機關ノ仕樣書ヲ調製シ、ソレカラ一種特別ノ船デゴザイマシテ色々ノ「カルキュレーション」ヲ致シマスニ大イニ私ヲ助ケタ人ガゴザイマス、ソレハ當時商船會社ニ居ラレマス人々デ船體部ノ方ハ工學士ノ玉川一房君又機關部ノ方ハ香月錠之助君此兩人ガ大イニ私ニ手傳ッテ盡力セラレマシタ、ソレカラ客室其他ノ配置ハ只今御覽ニ入レタ圖面ノ通リデゴザイマシテ此水路ニ付テハ重量ヲ減ズル爲メ通常海ヲ航行スル船ト其構造ヲ多少違ヘマシタ、ソレヲ一ツ二ツ申上ゲマス、此側面デ御覽ノヤウニ本船ニハ汽罐室ガ中央ニアッテ汽機室ガ船尾ニアル、此汽罐室ト汽機室トノ間ニ荷物ヲ積ム所ガアリマス、是レハナゼコンナコトニ致シタカト云フト、成ルベク楊子江水路ノ爲ニ輕イ荷物ヲ澤山ニ積ムヤウニ致シタイノデアル、ソレカラ又船ノ喫水ヲ成ルベク淺クスル爲ニ船體、汽機、汽罐ノ重量ヲ減シタイノデアル、此二ツノ點カラ船ヲ計畫致シマシタ之ヲ通常ノ商船ノ如ク汽罐室ト汽機室ヲ中央ニ置ケバ必ズ車軸室ハ中央ニアル汽機室カラ船尾ニ通ルノデゴザイマスガ、此船ハ特別構造ノ爲ニ支水壁ガ中央ニアリ「トンチル」ガ雙方ニアッタラバ此船尾ノ艙內ニハ幾ラモ荷物ハ積メナイ、ソレデ斯ノ如ク此汽罐室ト汽機室トヲ離シマスレバ荷物ノ點ニ付テ非常ニ利益ト考ヘテ斯ウ云フ風ニ致シマシタノデゴザイマス、ソレカラ又重量ノ點ニ付キマシテ多少利益ヲ得ルノデゴザイマス、此爲ニ「シャフト」ノ目方ハ全ク減リマス、只殖ルノハ「スチームパイプ」ハドウシテモ長ク導カナバナラヌカラ其重量ガ殖ル、併シ「シャフト」ト「スチームパイプ」トノ目方ヲ比較スレバ「シャフト」ノ方ガ多イ、此爲ニモウ一ツ增スノハ通常ノ商船デアレバ汽罐室ト汽機室トノ間ニ支水壁ハ無クトモ宜イガ、此船ハ是レガアル爲ニ重量ハ增シマシタケレドモ、此「トンチル」ノ重量ト支水壁ノ重量ト比較スレバ「トンネル」ノ方ガ餘程重量ガ多イ、詰リ此配置ノ爲ニ貨物ノ容積モ增シ、又船體機關ノ重量モ減ズルノデゴザイマス

ソレカラ此水路ニ最モ必要ナルモノハ舵デゴザイマス、此川ハ隨分屈曲ガ多イノミナラズ、此水路ハ時々土砂ノ爲ニ變リマスカラ餘程舵行キノ良イ船デナケレバ安全ニ航行ガ出來ナイ、其爲ニ已ムヲ得ズ非常ニ大ナル舵ニセネバナラヌ、此際計畫シマシタ船ハ舵ノ幅ヲ八尺有餘ニ致シマシタ、其形狀ハ此圖ニ表ハシタ形狀デゴザイマス

ソレカラモウ一ツ申上ゲマスノハ此航路ノ船ハ通常海デ使フ「スターンチユーブ」ノ構造デハ差支ヘガアル、若シ通常ノ船ノヤウニ「スターンチューブ」ノ摩擦面ガ兩端ノミデアルト此川デハ土砂ガ這入ッテ

「スターンチユーブ」ノ「ブシ」ハ二タ月カ三月デ耗ツテ仕舞マス、ソレヲ防禦スルニハ摩擦面ヲ廣クスルホカ仕方ガナイカラ「スターンチユーブ」則チ船尾管内ノ全部ヲ摩擦面ニ致シタノデゴザイマス、ソレカラ又一ツ海上ノ船ト違ヒマスノハ川デアルカラ種々樣々ノ流レモノガアリマス、ソレガ往々此暗車ニ卷附キマシテ航行ノ妨ゲヲナスコトガゴザイマス、是等ヲ防禦スル爲ニ「アングルアイロン」ト「ハーフラウンドバー」ヲ以テ圖面ノ如キ物ヲ拵ヘマシタ、是レハ只暗車ニ流レモノガ卷附クノヲ防グ一ツノ方法デゴザイマス



ソレカラ客室ノ配置ハ先刻チヨット申上ゲマシタガ、少シ異ツテ居リマス、此表面圖ニアル通リ此水路ニハ歐羅巴ノ「ファーストクラス」則チ上等ガアリ、支那ノ「ファーストクラス」則チ上等ガアリ又支那ノ「セコンドクラス」則チ中等ガアリ、ソレカラ「サードクラス」則チ通常ノ下等、是レダケニナツテ居リマシテ歐羅巴ノ「ファーストクラス」則チ上等ハ通常ノ船ノ裝置ト少シモ違ヒマセヌ、支那上等中等ト云フノハ重ニ支那官吏、商人ガ乘ルノデアリマシテ夫等ノ人ニ適當スルヤウニ拵ヘネバナラヌカラ其裝置ハ當リ前ノ寢臺ヲ置キ、ソレカラ食卓ナドハ通常ノ歐羅巴ノ卓デナク、支那人ハ圓イ卓ヲ使ヒマスカラ皆圓イ卓ヲ使ヒ、又部屋ノ中ニハ阿片臺ヲ据付ケタノデゴザイマス、先ヅ歐羅巴ノ二等客室ヨリ或ル部分ハ少シ劣ツテ居リ、或ル部分ハ優ツテ居リマス、下等ノ方ハ通常ノモノト變ラナイデ二段ニ棚ガ出來テ居ツテ一人〳〵休ムヤウニ仕切ガシテアル

ソレデ此船ヲ二艘三十一年六月ニ大阪商船會社デ拵ヘルコトニナツテ一艘ヲ大亨丸、一艘ヲ大利丸ト名ヲ付ケ、其六月ニ大亨丸ヲ長崎ノ三菱造船所ニ注文シ、大利丸ヲ神戸ノ川崎造船所ニ注文シマシタ、又本年ノ初メ更ニ上海漢口間ノ水路ニ一艘ト、ソレカラ漢口宜昌間ノ水路ニ一艘更ニ拵ヘルコトニナリマシタガ、マダ其頃マデハ此大亨丸大利丸ハ落成イタシマセヌデ十分ニ前ノ計畫ノ結果ヲ見ルコトガ出來マセヌカラモウ少シ此計畫ニ付テ改良シタイト思ヒマシテ私ハ上海ニ當年

三月參リマシテ當時上海造船所ニ於テ製造中ノ一二ノ船ヲ見テソレカラ歸リマシタ上デ更ニ又計畫ニ著手イタシタノデゴザイマス、此度ハ前ト少シ變ヘマシテ此上海漢口間ノ水路ニ使ヒマス船デ當年計畫シタ船ハ長サハ矢張リ同ジコトデ二百七十尺、幅四十尺、龍骨ノ上面ヨリ重甲板ノ上面マデ十三尺、重甲板ノ上面ヨリ「プロメネードデッキ」ノ上面マデ八尺、「プコメチードデッキ」ノ甲板ノ上面ヨリ「セイドデッキ」ノ上面マテ七尺三吋、ソレカラ總噸數ヲ此度ハ二千五百噸ニ致シマシテ滿載喫水ヲ九尺六吋トシテ石炭食糧飲料水其他ヲ差引キマシテ全ク貨物ヲ積載スル噸數ヲ七百噸ト云フコトニ致シマシタ、汽機ハ矢張リ三聯成デ推進機ハ雙暗車、汽機ノ寸法ハ高壓ガ十六吋、中壓ガ二十六吋、低壓ガ四十三吋、行長ガ三十吋、表面冷汽器總面積ガ貳千八百平方尺汽罐ノ壓力ガ百八十磅デ、此度ハ汽罐ノ計畫ヲ少シ變ヘマシタ、前ハ通常使フ自然通風デ「ダブルエンデッドボイラー」ヲ使ッタガ、今度ハ「ハイデン」式ノ强壓式ヲ用ヒテ汽罐ハ二ツニシテ「シングルエンデッドボイラー」ヲ使フコトニ致シマシタ、汽罐ノ大キサハ徑十四尺九吋、長サガ十尺六吋受熱總面積ガ四千平方尺、火床面積ガ百三十平方尺、實馬力ガ自然通風デ凡ソ千三百以上、强壓通風デ千七百以上デアル、ソレカラ速力ハ喫水ガ九尺六吋ニシテ自然通風デ十一海里、强壓通風デ十二海里デアル、ソレデ前ノ計畫ト今度ノ計畫トノ違ヒヲ申上ゲマスト、是レハ私ガ工夫シタ譯デハアリマセヌガ、上海ニ參リマシテ一二ノ船ヲ見タノデアリマス、此中央截斷圖ニアル如ク暗車船デモ外車船ノ「パッドルボックス」ノ如ク「デッキ」ニ張出シヲシテ前後ニ通シテアル船ガアル、ソレデ斯ノ如ク輕量ノ貨物ノ多イ所デアッテ此船ノ中デ重甲板以下ハスッカリ貨物デ、重甲板以上モ輕量ノ荷物ヲ澤山積ミマスカラ此方ハ容積モ非常ニ增シマスノデ此方法ヲ採用イタシタノデアリマス、之ニ據リマスト「セイドデッキ」ト「プロメチードデッキ」ノ間ノ客室モ廣クスルコトガ出來マス、此「プロメチードデッキ」ト「メインデッキ」トノ間ニ下等ノ客ヲ乘セ或ハ輕量ノ貨物ヲ積ムノデ此容積ガ非常ニ增シマスカラ夫等ノ爲ニ此方法ヲ用ヒタノデゴザイマス、通常ノ外車船デアリマスト只中央部ダケニ張出テ居リマスガ是レハ船尾カラ船首迄「カーブ」ニナッテ張出テ居リマス、前ニ計畫ノ船ハ船體ノ中央ニ縱通ノ支水壁ヲ置イタガ、今度ハ船ヲ少シ深ク致シテソレヲ止メルコトニシテ多少此「スカントリング」デモ減シ得ベキ見込ミノモノハ前ノ船ヨリ減シテ計畫イタシマシタ、ソレデ此船ハ前ノ船ヨリハ多少重量ヲ減シ得ルコトガ出來マシタ、ソレカラ中央ノ縱通支水壁ガ無クナリマシタカラ汽罐室ト汽機室トヲ通常ノ船ノヤウニ中央部ニ置イテサウシテ「トンチル」ヲ置キマシタ、モウ一ツノ違ヒハ前ハ「ナチユラルドラフト」ニシテ「ダブルエンデッド」ノ罐ヲ使ヒマシタガ「ダブルエンデッド」ノ罐ハ非常ニ積ヲ取ッテ雙方ニ「ストークホールド」ガ要リ、罐ノ重量モ非常ニ殖マスカラ、是レハ私ガ上海ニ參ッテ段々各汽

船ノ航行ノ模樣ヲ見マシタガ、此川ヲ航行スル汽船ハ何時モ自分ノ力一パイノ速力デ走ツテ居ラヌ、偶々競爭スル汽船ニ遇ツタ時ハ速力ヲ出シテ烟突ガ赤クナル位ニ火ヲ焚イテ競爭シテ居リマスガ、其必要ノ無イ時ハ無暗ハ石炭ヲ消費セズ相當ノ速力デヤツテ居リマス、丁度軍艦ガ通常ノ時ハ「ナチユラルドラフト」デヤツテ居ルガ、イザ敵ニ遇ツタ時ハ「ホースドドラフト」ヲ使フト同ジ考ヘヲ起シマシタ、ソレデ「シングルエンデッドボイラー」ニシテ平素ハ十一海里ノ速力ニシテイザ敵ニ遇ツタラ十二海里以上ノ速力デ走ルト云フ計畫ニシテ其他重量ヲ大イニ減ジテ先刻申シタ通リ七百噸位ノ重量ヲ積載シ得ルコトニ致シタノデゴザイマス、ソレカラモウ一ツ計畫シマシタノハ漢口カラ宜昌ノ間ハ先刻申上ゲマシタ如ク水路ノ中デ最モ惡イ所デゴザイマシテ冬ノ一番淺イ時ハ六尺内外デアルカラソレニ適當シタ構造デナケレバナラヌ、此船ノ長サハ二百五十尺、垂線ノ長サ、最大ノ幅ハ四十尺、ソレカラ龍骨ノ上面ヨリ重甲板ノ上面マデ十尺三吋、重甲板ノ上面ヨリ「プロメチードデッキ」ノ上面マデ七尺九吋、「プロメチードデッキ」ノ上面ヨリ「セイドデッキ」ノ上面マデ七尺三吋、總噸數ハ千九百噸ト云フノデゴザイマス、ソレカラ滿載喫水ガ六尺、其六尺ノ喫水デ石炭飲料水食糧其他ヲ除キマシテ全ク荷物ヲ載セ得ベキ力ガ三百八十噸デアル、ソレカラ汽機ハ矢張リ三聯成デ推進機ハ雙暗車、高壓ハ十三吋、中壓ハ二十一吋半、低壓ハ三十五吋四分ノ一、行長ガ二十四吋デアル、夫カラ汽罐ハ通常ノ圓形デ「シングルエンデッドボイラー」ガ二個デ其直徑十四呎三吋其長十呎六吋其壓力ガ百八十磅、表面冷汽器總面積ガ二千百平方尺、汽罐受熱總面積ガ三千六百平方尺、火床面積ガ百二十平方尺、實馬力ガ千二百以上デ滿載喫水六呎ニテ十海里半ノ速力ト云フノデゴザイマス、此構造ノ船ハ大享丸大利丸ノ二艘トハ違ヒ非常ニ淺イ船デゴザイマシテ汽機室ヲ船體ノ中央ニ置キ、「シヤフト」ヲ船內ニ設ケマシテハ殆ド後艙內ニ荷ガ積メナイ有樣デアルカラ汽機室ヲ船尾ニ設ケマシテ汽罐室ヲ中央ニ設ケタノデゴザイマス、ソレカラ縱通ノ「バルクヘッド」ガ船首カラ船尾ニ通ツテ居リマス

ソレデ當年計畫イタシマシタ一艘ハ二千五百噸デ此方ノ船ハ商船會社デ大貞丸ト命名シテ長崎ノ三菱造船所ニ注文ニナリマシタ、ソレカラ只今御話シマシタ二百五十尺ニ千九百噸ノ船ハ是レハマダ名前ハ未定デゴザイヽスガ、大阪ノ鐵工場ニ注文ニナツテ居リマス、此大貞丸外一艘ノ計畫ニ付キマシテハ四人ノ方ガ大イニ私ノ爲ニ盡力サレマシテ船體部ノ方ハ工學士ノ玉川一房君ト工學士ノ小島精太郎君デゴザイマス、又機關部ノ方ハ香月錠之助君ト工學士ノ笹瀨誠一君デゴザイマス、此四人ガ圖面幷ニ仕樣書等ノ調製其他「カルキユレーション」等ニ大變盡力サレマシタ、ソレデ一昨年計畫イタシマシタ、大享大利ト云フ二艘ハ當年ノ夏落成イタシ、サウシテ楊子江ニ參ツテ各國ノ汽船ノ中ニ交ツテヤツテ居リマシテ其優劣ニ付テ色々聞キマシタコトガゴ

ザイマスカラ其事ヲチヨツト御話イタサウト思ヒマス

此大享丸ハ先刻申シマシタ如ク長崎ノ三菱造船所ニ注文シテ當年七月ニ落成シ、大利丸ハ本年八月ニ神戸ノ川崎造船所デ落成シマシタガ、試運轉ノ際ニハ私ハ參リマセヌ、其際參ツタ人カラ聞キマシタカラ其結果ニ付テ申上ゲマスガ、此兩船トモ喫水九尺マデノ貨物ヲ積ンデ十二海里ノ速力ヲ出スコトヲ此造船所デ保證サレマシタガ、ソレヨリ遙カ上ニ出テ殆ド十二海里半ノ速力ガ出タト云フコトデゴザイマス、ソレカラ荷物ヲ減ジテ六尺ノ輕喫水デ速力ヲ試ミマシタ時ニ十三海里以上ノ速力ガ出テ非常ニ好結果デアリ、又船體汽機汽罐ノ構造其他ニ於テモ少シモ申分ノ無イホドニ落成シタト云フ報告ヲ得マシテゴザイマス、其後此大享丸ガ上海ニ參ツテ航行シテ從來航行シテ居ル二三ノ船トノ比較上ノ優劣ヲ聞キマシタカラ其事ヲチヨツト御話シマスガ、此大享丸ガ上海ニ到著シタ際ニ「メルチヤース」ト云フ獨逸人ノ會社ガアツテ其會社ガ上海造船所デ美利、美福ト云フ二艘ヲ拵ヘタガ、此二艘ヲ拵ヘサセタ人ガ大享丸ヲ見ニ參ツタ、其見ニ參ツタ人ハ此會社ノ支配人ト監督トソレカラ美利ノ船長デゴザイマシタガ、スツカリ船ヲ見テ自分ガ上海デ拵ヘタ船ハ非常ニ劣ツテ居ルト云フコトデアリマシタ、此美利、美福ハ大キサハ確ニ分リマセヌカラ表ニハ載セマセヌガ、長サガ二百五十尺デ大凡二千噸位ノ船ダト云フコトヲ聞キマシタ、サウシテ其船價ハ大享丸ヨリ高イカラ非常ニ自分ハ上海ニ注文シタノハ失策ダト言ツテ居ツタノガ大享丸ヲ見テノ一ツノ評デゴザイマス、モウ一ツハ此大享丸ノコトニ付テ我日本帝國ノ漢口領事ノ瀨川君ヨリ外務省ヘ此川ノ航海ノ船ニ付テ報告ガ出テ居リマスガ、其報告ノ中ニ大享丸ニ付テ内外人ノ評ガ出テ居リマス、是レハ官報ニ出テ居リマスカラ諸君ノ中ニハ御覽ニナツタ方モアリマセウガ、チヨツト大享丸ノ部分ダケヲ讀上ゲマス

昨三十二年六月六日大利丸ヲ川崎造船所ニ大享丸ヲ長崎三菱造船所ニ對シテ各々新造注文ノ手續ヲ終ヘ兩者トモ竣工期限ハ本年九月五日ナリシ由ナルカ大享丸ハ豫定ノ日數ヲ要セスシテ七月三十日ニ竣工シ越テ八月七日朝上海ヘ廻航シ諸般ノ準備ヲナシ茲ニ初メテ天龍川丸ト交代シテ同十四日上海ヲ拔錨シ第一回ノ溯航ヲ試ミ同十七日當漢口ヘ著シ翌十八日再ヒ定期ノ如ク下航シテ上海ヘ到著以來非常ニ内外人ノ賞讃ヲ博シ目下長江航行ノ諸汽船中第一位船トノ評ヲ受クルニ至レリ

是レダケガ要點デゴザイマスガ、今非常ニ内外人ノ評判ガ宜イノデゴザイマス、引續キマシテ大利丸モ向フヘ參リマシタガ、兩船トモ斯ノ如キ有樣デアルカラ非常ニ喝采ヲ得タト思ヒマス、是レハ全ク三菱造船所ト川崎造船所ガ充分注意サレテサウシテ船主ノ希望ニ從ツテ手腕ヲ奮ハレタ結果デアラウト思ヒマス

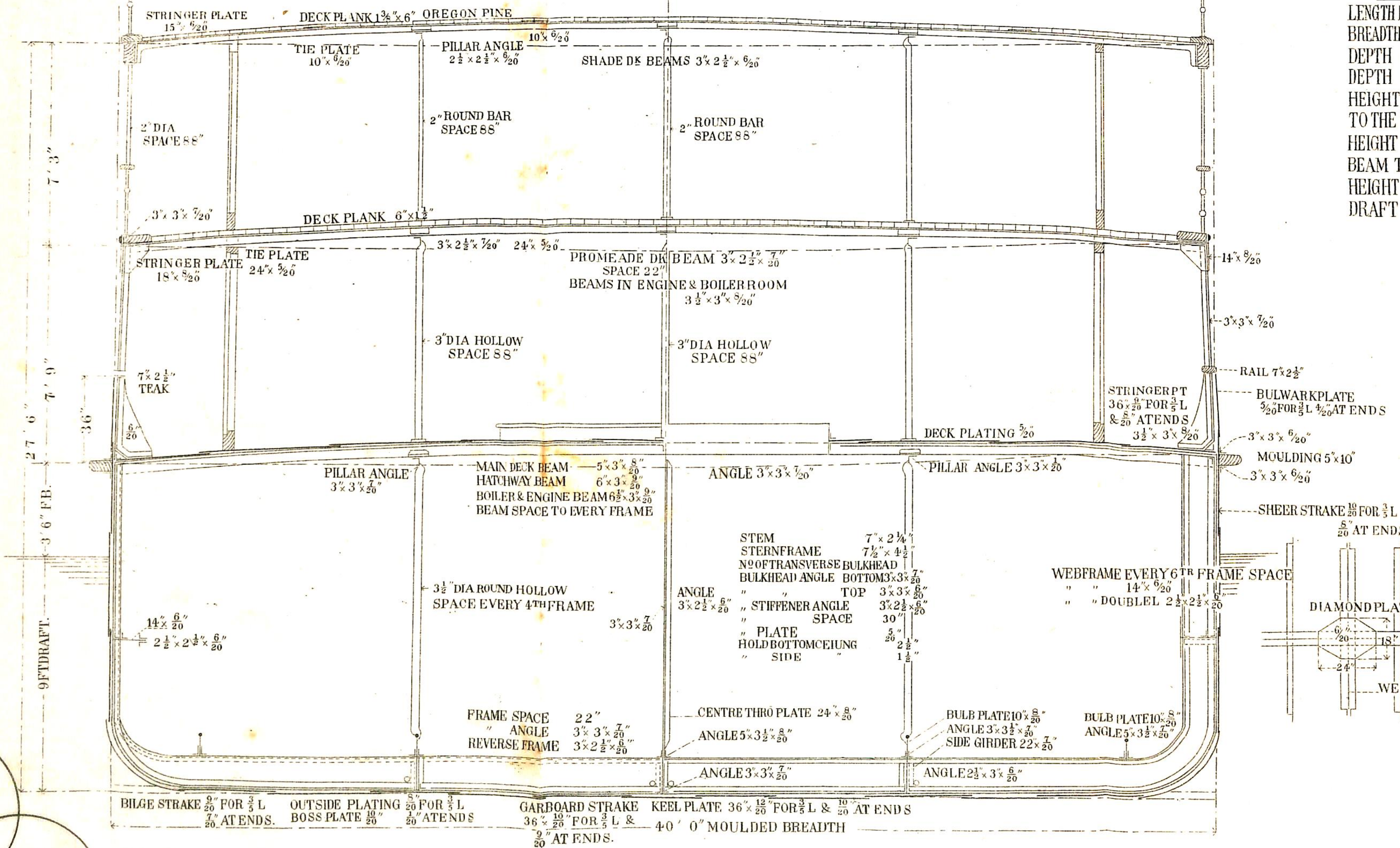
ソレデ私ハ先刻御話シタ如ク只ホンノ大體ノ計畫ヲ決メタノミデ其他詳細ナルコトハ皆三菱造船所ト川崎造船所デヤツテ貰ツテソレ〳〵製造所ノ方ガ實地ニ製造サレタノデゴザイマス、當時揚子江ニ於テ英國屈指ノ造船所幷ニ上海造船所等ニテ製造サレタル色々ノ種類ノ船ノ中

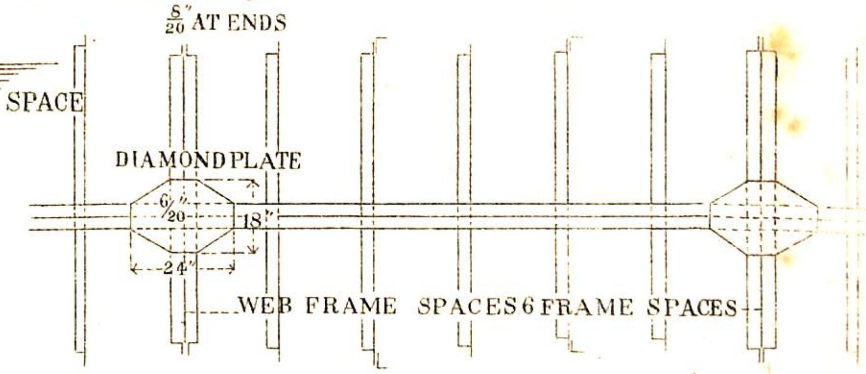
デ一番良イト云フ評判ヲ得タノハ實ニ我造船事業ノ爲メ賀スベキコトデゴザイマス、餘リ長クナリマスカラ此位ニシテ措キマス

MIDSHIP SECTION

OF TWIN SCREW SHALLOW DRAUGHT STEAMER

SCALE $\frac{1}{4}$" = ONE FOOT





PRINCIPAL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	270' 0"
BREADTH MOULDED	40' 0"
DEPTH MOULDED TO M.D.K	12' 6"
DEPTH M. TO SHADE DECK	27' 6"
HEIGHT FROM THE TOP OF M.D.K BEAM TO THE TOP OF PROMENADE DK BEAM	7' 9"
HEIGHT FROM THE TOP OF PROM. DK BEAM TO THE TOP OF SHADE DK. BEAM	7' 3"
HEIGHT OF DK. HOUSE ON SHADE D.K	7' 3"
DRAFT LOADED	9' 0"

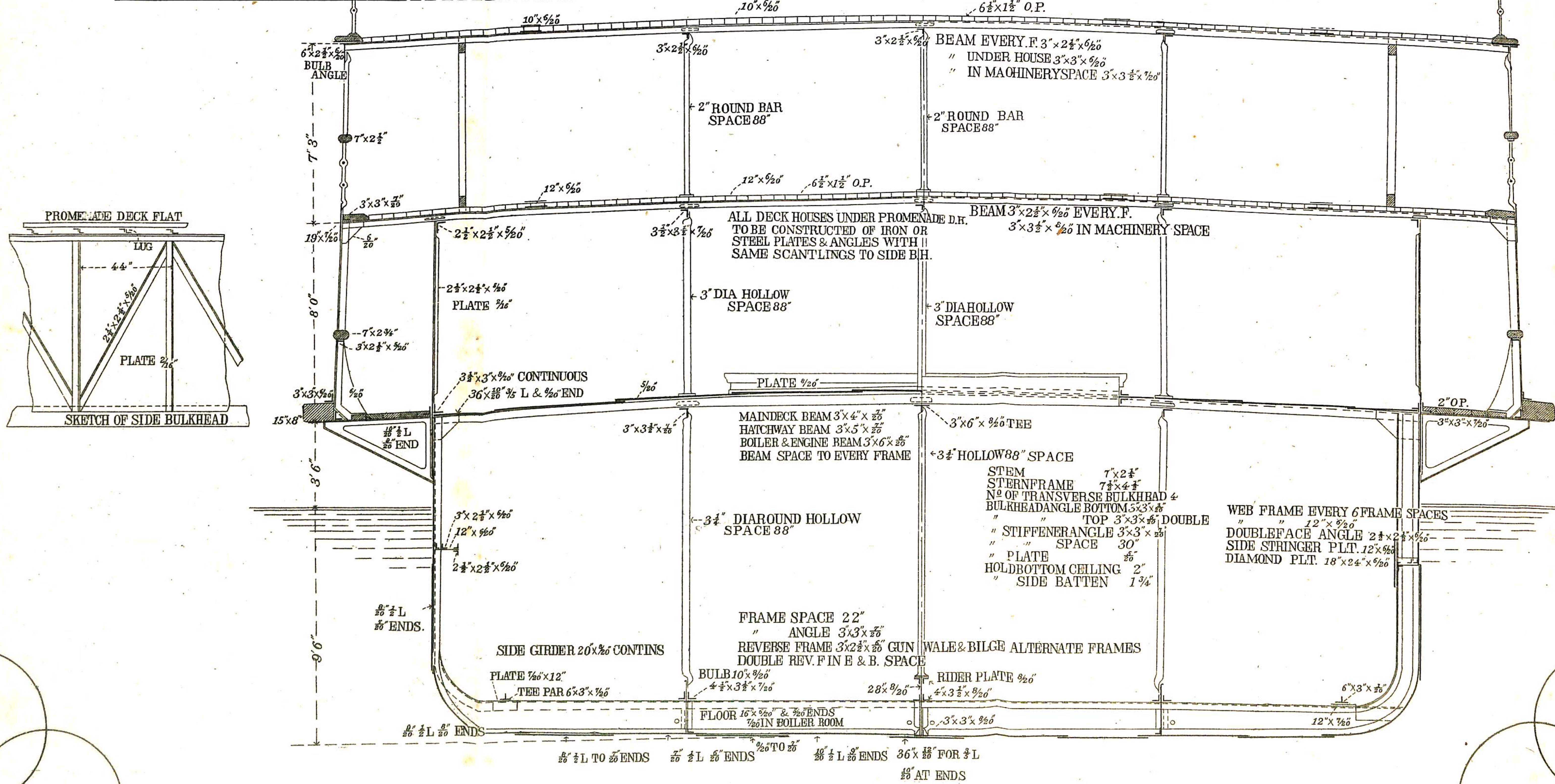
PRINCIPAL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	270 FT. 0 IN.
BREADTH MOULDED	40 FT. 0 IN.
DEPTH MOULDED TO MAIN DECK	13 FT. 0 IN.
DEPTH MOULDED TO PROMENADE D.K.	21 FT. 0 IN.
DEPTH MOULDED TO SHADE DECK	28 FT. 3 IN.
LOADED DRAUGHT	9 FT. 6 IN.
HEIGHT OF SHADE DECK HOUSE	7 FT. 3 IN.

MIDSHIP SECTION

OF TWIN SCREW SHALLOW DRAUGHT STEAMER

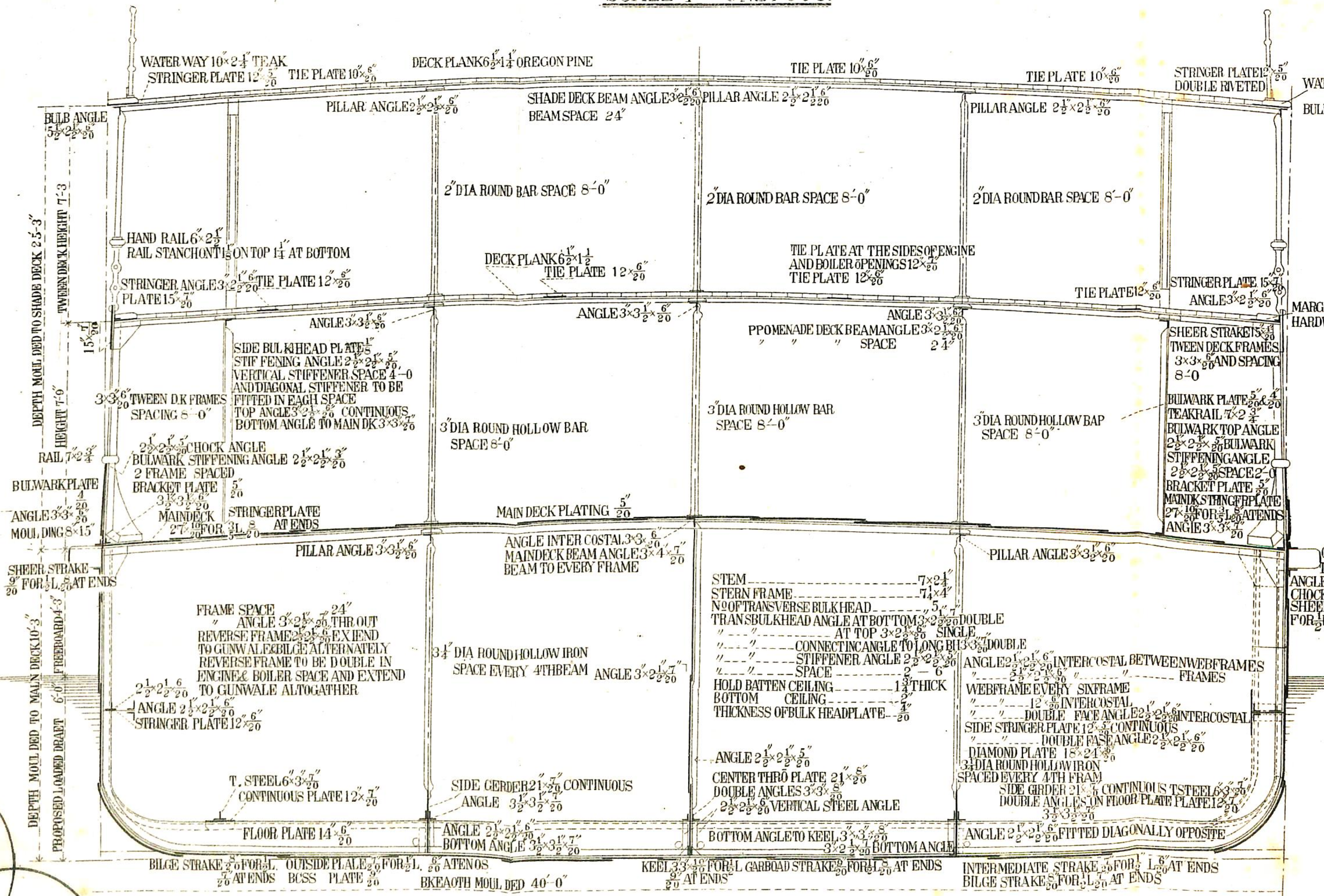
SCALE 1/4" — ONE FOOT



MIDSHIP SECTION

OF TWIN SCREW SHALLOW DRAUGHT STEAMER

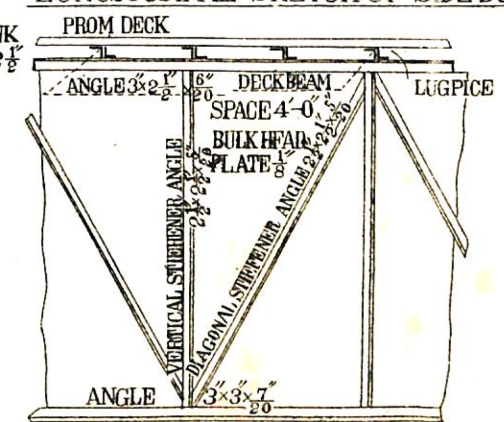
SCALE 1/4" = ONE FOOT.



PRINCIPAL DIMENSIONS

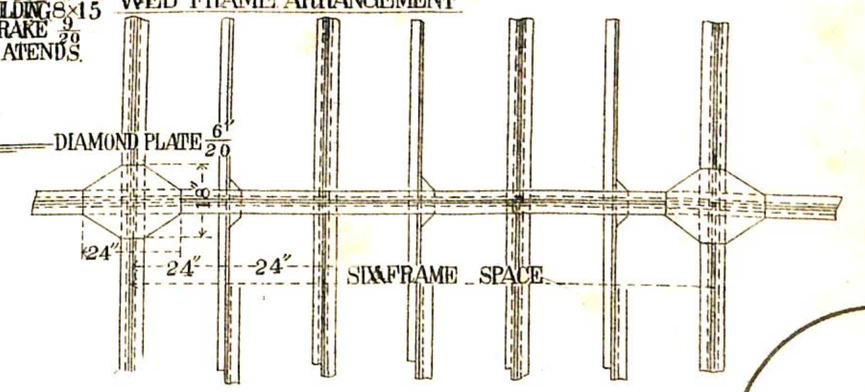
LENGTH BETWEEN PERPENDICULARS	250' 0"
BREADTH MOULDED	40' 0"
DEPTH MOULDED TO MAIN DECK	10' 3"
DEPTH M TO SHADE DECK	25' 3"
HEIGHT FROM THE TOP OF M DK BEAM TO THE TOP OF PROMENADE DK BEAM	7' 9"
HEIGHT FROM THE TOP OF PROMENADE DECK BEAM TO THE TOP OF SHADE DK BEAM	7' 3"
HEIGHT OF DK HOUSE ON SHADE DK	7' 3"
DRAFT LOADED	6' 0"

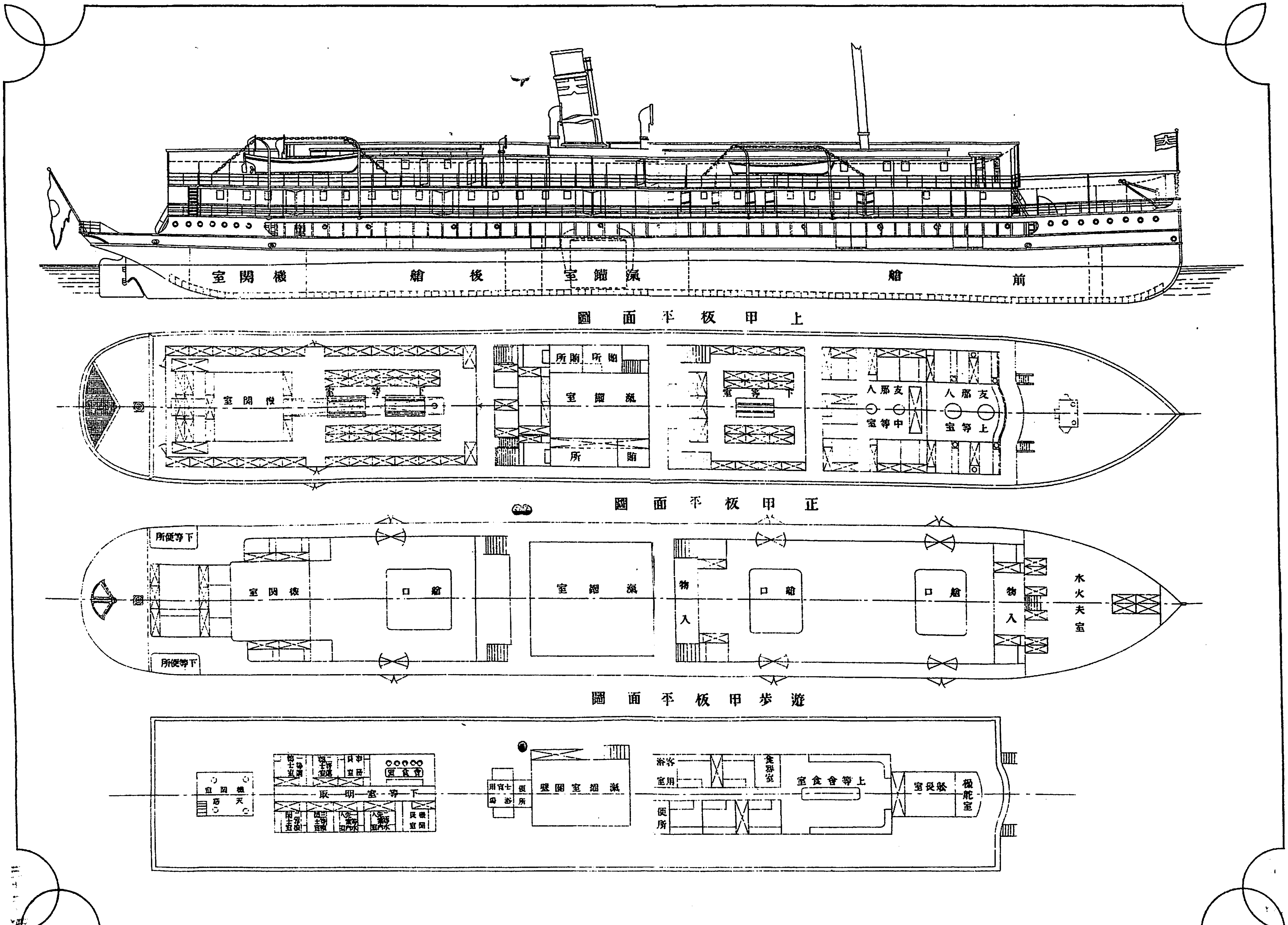
LONGITUDINAL SKETCH OF SIDE BULKHEAD

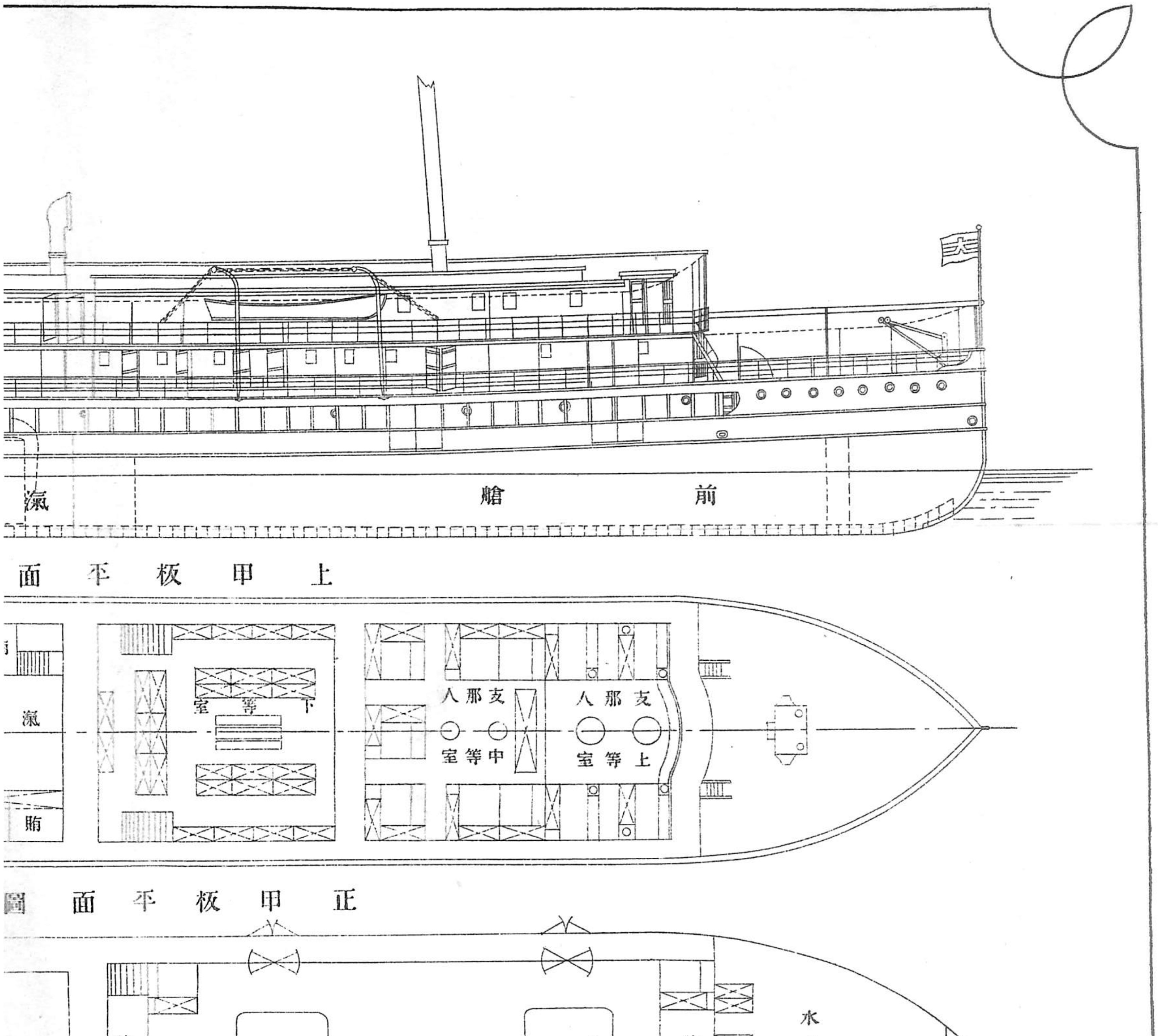


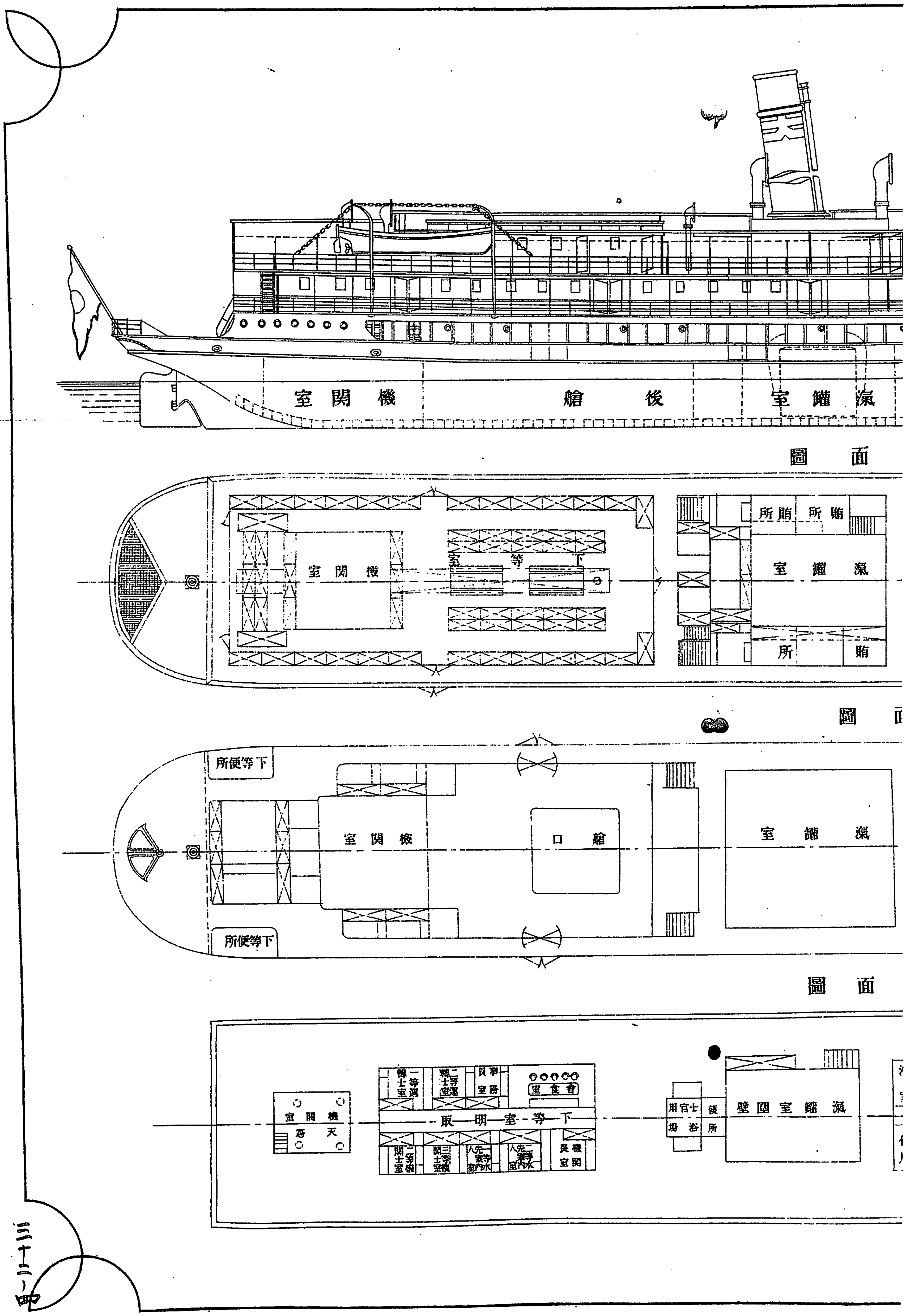
STEEL MAIN DECK

WEB FRAME ARRANGEMENT




機関室
後艙
前艙
上甲板平面圖
機関室
下等室
支那人中等室
支那人上等室
正甲板平面圖
下等便所
機関室
艙口
艙口
艙口
入物
入物
水火夫室
遊歩甲板平面圖
上等會食室
便所


前艙
上甲板平面
支那人上等室
支那人中等室
下等室
正甲板平面圖
艙口
艙口
物入
物入
水火夫室
遊歩甲板平面
上等會食室
食器室
浴室
客用
便所
船長室
操舵室



機関室
後艙
汽鑵室
面圖
機関室
下等室
汽鑵室
賄所
賄所
賄所
面圖
下等便所
下等便所
機関室
艙口
汽鑵室
面圖
機関室天窓
下等室明取
食堂
汽鑵室圍壁
便所

清國揚子江航行汽船表

現今揚子江中ニ航行シ同溜業ニ從事ノ汽船并ニ建造中ノ汽船ハ左表ノ如クニシテ

上海漢口間ヲ航通シ運漕業ヲ營ミ居ル會社九會社アリ其ノ汽船左ノ如シ

	船名支那字	同英字	製造年月	製造人	總噸數	汽機寸法	推進機
招商局	江裕	Kiangyu	1883,	J. Englis Glasgow	3098	40×75/96	外車
China merchant steam ship Company	江孚	Kiangfoo	1874,	Shanghai S. Nav Co. Shanghai	2300	80/183	外車
官民合同支那人	江通	Kiangyung	1876,	J. Englis Glasgow	1640	88×69½/84	外車
株式會社	江寛	Kiangkwang	1876,	J. Englis Glasgow	1611	89×69½/84	外車
印度支那蒸氣航通會社	元和	Yuenwo	1883,	Farnham & Co. Shanghai	2540	26×50/86	双暗車
Indo-China steam navigation company	吉和	Kutwo	1895,	London & Glasgow Scotland	2665	14×28×81/80	双暗車
英人	瑞和	Suiwo	1896,	London & Glasgow Scotland	2672	14×28×87/80	双暗車
支那航通會社	安慶	Nagnking	1883,	Scott Grenock	2732	22½×45/80	双暗車
China navigation company	大通	Tatung	1891,	Scott Grenock	2548	14×23×37/80	双暗車
株式會社 英人	鄱陽	Poyaug	1891,	Scott Grenock	2500	14×23×37/80	双暗車
「グリーヴス」會社	德興	Tehsing	1890,	Farnham & Co. Shanghai	1642	16×32/24	双暗車
Greaves & Co.	長安	Changon	1890,	Farnham & Co. Shanghai	1393	16×32/24	双暗車
英人名義	益利	Ella	1884,	N. of Ennglnod S. B. Co. Sundnland	2058	27×34×65/42	單暗車
支那人合資	寶華	Paohua	1885,		665	12×21/18	單暗車
「マクベイン」會社	萃利	Sual	1873,	T. Riach Hongkong	1037	28×48/24	單暗車
Mc. Bain & Co. 英人	華利	W. Course deVries	1865,	Rotterdam	962	16×36/36	單暗車
大阪商船株式會社	大亨		1900,	三菱造船所 長崎	2200	16×26×48/30	双暗車
日本人	大利		1900,	川崎造船所 神戸	2200	16×26×48/30	双暗車
	大貞		製造中	三菱造船所 長崎	2500	16×26×48/30	双暗車
「アーノルドカーウェル」會社 Arnold Cawel & Co.	瑞安	Suian	1900,	Farnham & Co. Shanghai	1200		双暗車
獨逸人	瑞泰	Suitai	1900,	Farnham & Co. Shanghai	1200		双暗車
「メールチャース」會社 Melchers & Co.	美利		1900,	Farnham & Co. Shanghai			双暗車
獨逸人	美福		1900,	Farnham & Co. Shanghai			双暗車
魚鱗洋行支那人	瓊港		1865,	James Taylor America	467	21×35/18	單暗車

漢口宜昌間ヲ航通シ運漕業ヲ營ミ居ル會社六會社アリ左ノ如シ

	船名支那字	同英字	製造年月	製造人	總噸數	機汽寸法	推進機
支那航通會社	沙市	Shashi	1891,	Scott Grenock	1090	104×16×25/18	双暗車
China navigation company	固陵	Kuling					双暗車
英人	洞庭	Tonting	1900,	Boyd & Co Shanghai		12×26×38/21	双暗車
大阪商船株式會社	大元		1899,	川崎造船所 神戸	1080	12½×21×34/21	双暗車
日本人	一隻船名未定		製造中	大阪鐵工所 大阪	1800	13×21½×35½/24	双暗車
「アーノルド、カーウェル」會社 Arnold Cawel & Co.	一隻 獨國ニ於テ建造中						
「メルチャース」會社 Melchers & Co.	一隻 獨國ニ於テ建造當時上海ニ回航中						
招商局 C. M. S. S. Co.	快利	Kweilee	1893,	Napier Shanks Bell Glasgow	1055	13×19×33/21	三暗車
印度支那蒸氣航通會社 Indo-China S. N. Co.	昌和	Chaugwo	1891,	Farnham & Co. Shanghai		17½×30/60	船尾外車

近時ノ商船

明治三十三年十月二十八日造船協會講演會ニ於テ

寺野精一

近時ニ於テ商船ノ大サ著シク增加セシハ既ニ一般ニ認識セラルヽ處ナレバ爰ニ喋々スルヲ要セサルナリ而シテ次ニ揭グル「ロイド」社年報中世界各國ニ於ケル造船統計ノ一節ヲ見レバ其進歩ガ如何ニ速カナリシカヲ知ルヲ得ベシ

	明治二十八年中製造ノモノ	明治三十年中製造ノモノ	明治三十二年中製造ノモノ
壹萬噸以上	一	三	一五
八千噸以上壹萬噸未滿	三	五	七
六千噸以上八千噸未滿	六	一五	三二

又過去五十年間ニ於テ大サノ進歩セル割合ハ實ニ次ニ述ブルガ如シ

（コルテル博士ノ調査ニ依ル）

千八百四十八年ニ於ケル最大商船二十隻ヲ平均スレバ其長サ二百三十呎、幅三十六呎、二、深二十三呎、喫水十九呎、總噸數千四百三十、平均速力九、二海里ニシテ實ニ此時代ニ於ケル最大速力ハ僅々十海里ニ過ギザリキ然ルニ一昨九十八年現在ノ最大商船二十隻ノ平均ヲ擧グレバ長サ五百四十一呎、幅六十一呎、深三十九呎、喫水二十九呎總噸數一萬〇〇十七、平均速力十八海里ニシテ最速ノ船ハ二十二海里ノ速力ヲ有シ今年ニ至リテハ既ニ二十三海里ノ快速力ヲ見ルニ至レリ斯ノ如ク僅ニ五十年間ニ於テ船ノ長サハ二倍、三五ヲ增シ幅ニ於テ一、七倍深ニ於テ一、七倍幷ニ喫水ニ於テ一、五三倍ノ增加ヲ見ル而シテ尙此割合ヲ以テ進歩スルモノトセバ長サ千呎ノ大汽船ヲ見ルコト亦タ遠キニ非ラザルガ如シ

抑モ大船カ小船ニ比シテ貨物運搬ニ於テ利益アルハ明白ナル事實ニシテ世界各國貿易ノ發達ニ伴フテ船ノ大サノ增加セルハ決シテ怪ムニ足ラザルナリ而シテ船ノ大サヲ增スニ就テ經濟上最利益多キ方法ハ長幅深ヲ同樣ニ增加スルニアリト雖モ如何セン各國港灣運河等ノ現況ハ喫水ヲ或ル制限以上ニ增加スルコトヲ許サヾルヲ以テ已ムヲ得ズシテ長サノミヲ比較的ニ增加セルハ前ニ述ブル統計ニ依テモ之ヲ知ルヲ得ベシ今春英國造船協會總會ニ於テ蘇國大學敎授バイルス氏ハ貨物船ノ大サニ就キテ有益ナル講演ヲナセルガ氏ノ計算ニ依レバ喫水ヲ增サヾレバ船ヲ大ニスルニ從テ載貨量一噸ニ對スル經費ヲ增加シ之ニ反シテ喫水ヲ增セバ船ノ大ナルニ從テ經費ヲ減スルヲ得ト云ヘリ此計算タルヤ船ノ强弱及復原力等ヲ標準トシテ長幅深及各部材料ノ寸法等ヲ增加スト假定セルモノナリ

故ニ喫水ヲ增サズシテ長サノミ增スハ不經濟ナル方法ナルガ如クナレドモ實際ニ於テハ既往五十年間ニ幅深等ニ於テハ僅ニ一、七倍ヲ增加セルニ長サノミハ實ニ二、三倍ヲ增シ尙今後ノ傾向モ專ラ長サヲ增ス

ニアルガ如シ之レ蓋シ已ムヲ得サルニ出ルモノト知ル可シ

各時代ニ於ケル最大ノ商船ハ殆ンド常ニ大西洋航行ノ旅客汽船ノ獨占スル處ナリシモ近來ハ貨物ノ總噸數一萬ヲ超ユルモノ尠カラズ「クナード」會社ノ「サクソニヤ」「イウバーニヤ」ノ如キ總噸數壹萬三千ヲ超ヘ白星社ノ「サイミリック」ノ如キモ壹萬二千五百ニシテ皆重量壹萬二三千噸ノ貨物ヲ運搬シ得ベシ

斯ノ如ク船ノ大サ進歩セルニ伴テ近時ノ商船ハ其構造及艤装等ニ於テモ亦著シキ進歩變遷ヲナセリ、今順序ヲ追テ進歩ノ概略ヲ左ニ述ベントス

構造ニ於ケル進歩ヲ攻究スルニ當リテ便宜上船ノ上部及底部トヲ區別シ先ツ上部ノ構造ニ就テ之ヲ述ブベシ

抑モ船體ハ心虚ナル切斷面ヲ有スル一ノ凾桁ト假定スルヲ得ベク從テ其强弱ハ大ニ假定桁搆ノ深サ及其上下ノ「フランヂ」ノ幅、厚等ニ關係ヲ有スルモノナリ故ニ近時大形商船ヲ設計スルニ當リテハ專ラ上甲板上ノ建物ヲ堅牢ニスルノ傾向アリテ終ニ「シエルター、デッキ」ト稱スル一種ノ甲板ヲ上甲板上ニ設クルニ到レリ之レ從來ノ船橋樓、船首樓及船尾樓甲板ヲ連續シタルモノニシテ全體ニ於テ從來ノ船橋樓等ニ比スレバ大ニ堅牢ニ構造シ殊ニ船橋樓、船尾樓等ノ斷絶セルガ爲メニ强力ノ激變ヲ起シ船體ニ種々ノ故障ヲ生ズルノ憂ヲ除去スルニアリ

斯ノ如クスレバ上甲板ノ搆造ヲ輕減スルヲ得ヘク殆ント同一重量ノ材料ヲ用ヒテ大ニ船ノ横斷面ノ「モーメント、オブ、イナーシア」ヲ增加シ從テ船體ノ强サヲ增加スルニ至ルベシ

「シエルター、デッキ」下ノ場所ハ主トシテ牛、羊ノ如キ若クハ一般ノ輕貨物ノ積載ニ適用スルモノ多キヲ以テ之カ爲メニ特ニ規定喫水ヲ增加スル、必要ヲ認メズ從テ此部分ニ支水壁ヲ設ケズ甲板上ニ大ナル艙口ヲ穿チテ「シエルター、デッキ」ヲ全ク日覆ヒ、雨覆ヒノ如クニ見做シ此部分ヲ全然總噸數ヨリ除去スルノ詭計ヲ用フルモノアリ然レトモ「シエルター、デッキ」ハ船ノ安全ノ點ヨリ論スルモ强サノ點ヨリ見ルモ極メテ有効ナル構造ナレバ英國ニ於テハ當局者モ寧ロ之レヲ奬勵スルノ趣旨ヲ以テ寛過スルモノ、如シ然レトモ場合ニ因テハ支水壁ヲ設ケテ法定喫水ヲ增シ客室トシテ若クハ通常ノ貨物積載ノ爲メニ使用スルモノモ尠カラズ而シテ此場合ニハ支水壁ヲ以テ包圍セラレタル部分ノミヲ噸數ニ積算スルモノナリ

「シエルター、デッキ」ガ船體ノ强サヲ增スニ有効ナルハ前ニ述フルガ如クナレトモ船ノ種類若クハ其使用ノ目的ニヨリテハ船橋樓船尾樓等ヲ連續スルヲ不便トスルコト尠シトセズ而シテ斯ノ如キ場合ニ同一ノ目的ヲ達スル爲メニ近來「シタデル、デッキ」ト稱スルモノヲ設クルニ至レリ之レ從來ノ船橋樓甲板ヲ意味スルモノナレトモ後者ニ比シテ大ニ堅牢ニ構造シ其兩端ニ於テ甲板ノ斷絶スル部分ニハ特ニ意ヲ用ヒテ强力ノ激變ニ應ス可キ裝置ヲナセリ第一圖ニ示スモノハ其一法ニシテ

「アメリカン、ライン」ノ爲メニ目下蘇國クライドバンク、ノ「ジヨン、ブラウン」社ニ於テ新造中ノ貨物船(長五百六十呎)ニ用ヒタルモノナリ之レ「シタデル、デック」ト上甲板ト强サノ連續ヲ全カラシメントスルニアリ

斯ノ如ク上甲板上ニ「シエルター、デック」若クハ「シタデル、デック」等ヲ設ケテ桁構ノ深サヲ增シ「モーメント、オブ、イナーシヤ」ヲ大ナラシメ以テ船體ノ强サヲ增加スレドモ近時ノ大商船ニハ前記甲板上ニ尙一二ノ輕裝甲板ヲ有スルモノ尠カラズ是等ハ旅客室ノ覆ヒ又ハ旅客逍遙ノ爲メ若クハ端艇据付ノ爲メニ設クルモノニシテ性質上其構造極メテ輕裝ナルモノナレドモ船ヲ桁構ト假定スルトキハ是等ノ甲板ハ大ニ梁ノ深ヲ增スモ之ヲ構造スル材料少ニシテ同一ノ割合ニ横斷面ノ「モーメント、オブ、イナーシヤ」ヲ增スコト能ハズ從テ最上甲板ニ於ケル「ストレス」ハ却テ增加スルニ至ルコト尠シトセズ而シテ是等ノ輕裝甲板ヲ堅牢ニナシ各部寸法ヲ大ニシ適度マデ「モーメント、オブ、イナーシヤ」ヲ增サントスレバ不必要ノ材料ヲ搭載シ爲メニ船體ノ重量ヲ增シ載貨力ヲ減少スルニ至ルベシ故ニ是等ノ輕裝甲板ヲシテ「ストレス」ヲ傳ル點ニ於テハ全ク船體ノ主部ト關係ヲ絶タシムルヲ要ス而シテ此目的ヲ達スルニハ甲板室ヲ連續セシメズシテ個々獨立セシムルカ然ラザレバ日覆甲板及甲板室側板等ニ「エキスパンション、ジヨイント」ヲ用フルニアリ第二圖ハ其實例ノ二三ヲ示スモノナリ極メテ長キ巡洋艦ノ如キモ既ニ其必要ヲ感シ英艦「テリブル」以下新式ノ一等裝甲巡洋艦數隻ニハ「ボート、デック」ニ於テ之ヲ應用セリ之レ甲板若クハ甲板室側板ヲ横斷シ其接手覆板ヲ自由ニ伸縮シ得ル樣ニ裝置シ全ク「ストレス」ヲ受ケシメザルニアリ現ニ大形ノ旅客船ニ於テ此設備ナキガ爲メニ甲板室側板ニ横裂ヲ生シタルモノアリト云フ

次ニ船體底部及ヒ横通肋材ノ構造ニ就テノ變遷ヲ述フレバ肋材ハ近來深式肋骨ナルモノヲ多ク使用スルニ至レリ從來ノ商船ニテハ貨物ノ積載ヲ便ナラシムルガ爲メニ艙內ニ於ケル梁ヲ廢シ之レニ代ルニ每三四本乃至七八本目ノ肋骨ヲ特ニ堅牢ニ搆造シテ web frame ト稱スルモノヲ使用セシガ該特設肋骨ノ中間ニハ通常肋骨ヲ用フルヲ以テ大ニ横强力ノ不權衡ヲ生シ加之特設肋骨ハ艙內ノ載貨積ヲ減少スルノ不便アルヲ以テ近來ハ深式肋骨 Deep frame ナルモノヲ用フ其搆造從來ノ通常肋骨ニ比スレバ堅牢ニシテ特設肋骨ノ如ク深カラザルモノヲ各肋骨ニ附スルヲ以テ横强力ヲ均一ナラシメ艙內ノ載貨ヲ妨クルコト特設助骨ノ如ク大ナラザラシム而シテ機關室ノ如ク全ク梁ヲ設置スルコト能ハザル場所ニシテ殊ニ重量ヲ一局所ニ集合スル部分ニハ船體ノ横變形ヲ防ガンガ爲メニ深式肋骨ニ加フルニ特設肋骨ヲ附シテ特ニ堅牢ナラシム

從來ノ梁柱ナルモノハ通常每梁材ニ附スルヲ以テ艙內ニ於ケル載貨容積ヲ減ルノミナラズ貨物ノ積入等ニ妨害ヲ與フルコト甚シ故ニ最近

ノ貨物船ニハ第三圖ニ示ス如ク特ニ堅牢ニ構造セル梁柱三四本ヲ一艙内ニ配置シ各梁ノ下ニハ縱通ノ支梁ヲ設ケ甲板上ノ總重量ヲ該特設梁柱ニ適當ニ分配セシメタルモノアリ「ロイド」組合ノ如キハ未ダ之ヲ承認セズト雖モ此裝置ノ載貨上ニ便益アルハ言ヲ俟タズ又全體ノ强サニ於テモ從來ノ構造ニ比シテ決シテ遜色ナキヲ以テ漸然之ガ流行ヲ見ルニ至ラン

又近來ノ商船ハ殆ンド皆二重底ヲ備ヘ二重底ノ内外ニ於ケル肋骨ハ全ク別ニ構造シ肘板ヲ以テ二重底縁板ニ固著スルモノ多シ然ルニ船ノ大サノ增加スルニ從ヒ横變形ヲ防ク爲メニ二重底外ノ肋骨ト縁板ノ固著ヲシテ益堅牢ナラシムルノ必要ヲ感ジ數年前ヨリ大形船ニハ第四圖ニ示ス如キ構造ヲ見ルニ至リシガ最近ノ「ロイド」規則中ニ終ニ此條項ヲ新設セリ

船ノ長サノ增加セルト船首船底ノ形狀ヲU字形ニナスノ習慣トニ因リテ波濤中ニテ縱搖レヲナストキハ甚シク前部船底ヲ損傷スルモノ尠カラズ近來「クナード」社ノ「ルーカニア」及ヒ「カムパニア」號ガ特ニ船底前部ニ補强ノ追加構造ヲ施シタルガ如キ又米國製ノ最大汽船「セント、ルイ」ガ該部ノ脆弱ナルヲ實際ニ於テ認メタルガ爲メニ船首部約百呎程ヲ全然改造セシガ如キ其一例トシテ見ルヲ得ベシ故ニ近來ノ大形船及通常ノ船ニテモ船底ノ扁平ナルモノハ船首隔壁后部適當ノ距離ニ特ニ防撓ノ構造ヲナスニ至リ最近ノ「ロイド」規則中ニモ新ニ此一項ヲ追加セリ

其他船ノ大サガ適度ニアリシ頃ハ船體ノ横剪力（シヤリングストレングス）ノ如キハ殆ンド之ヲ度外視セシモ實際ニ於テ毫モ故障アルヲ聞カザリシガ近來船ノ大サノ增加ニ伴ヒテ横剪力ニ起因スル損害ヲ認ムルニ至リシヲ以テ最近ニ製造セラレタル大西洋汽船中ノ一ニハ船ノ前部剪斷力ノ最大ナル部分ニ於ケル彎曲部外板ノ縱縁累接合ニ三列鋲ヲ用ヒタルモノアルヲ實見セリ

尙船ノ大サノ變遷ト共ニ構造上著シキ進歩ヲ認ムルハ支水壁ナリトス千八百七十七年頃ノ「ロイド」規則ハ支水隔壁ノ防撓材（スチフナー）ヲ副肋材ト同寸法ナラシメ竪材ハ二呎六吋ノ心距ニ横材ハ甲板下十二呎以下ノ深サノ船ニテハ一個十二呎以上ノ船ニハ二個ヲ用ヒシメタリ然ルニ八十五年頃ノ規則ニテハ防撓材ヲ正肋材ト同寸法ニ增加シ横材ノ心距モ四呎ニ減少シ尙幅四十呎以上ノ船ニハ汽機室隔壁ニ竪防撓桁板（バーチカルウエツブ）一個ヲ設ケシメ各竪防撓材ト内底板及甲板トハ充分ニ鋲著スヘキコトヲ規定セリ九十二年頃ニ及デハ竪防撓材ノ内底板及甲板トノ取著ニ肘板ヲ用フ可キコトヲ規定シ四十呎以上ノ隔壁ノ横置防撓材ニ球山形材ヲ用ヒシメ船幅ニ從ヒ竪防撓桁板ノ數ヲ增加シ五十五呎以上ノ船ニハ三個ヲ設置セシム

翌九十三年ニ至リテ船首隔壁ノ横防撓材ハ皆球山形材トシ尙幅三十六呎以上ノ船ニモ竪防撓桁板ヲ附ス可キコトヲ規定シ又横置ノ球山形材ノ防撓材ハ船側ヘ肘板ヲ以テ固著セシメ或ル場合ニハ溝形ノ横防撓桁

梁ヲ用ヒシムルニ至レリ而シテ近時ノ大商船ニ於テハ益隔壁ノ防撓ヲ堅牢ニナシ横置防撓材ハ専ラ溝形桁板ニノミ重キヲ置キテ其他ノ横防撓材ヲ廢シ竪防撓材ノ深ヲ増シテ之ニ代フルモノアリ之レ船幅ハ深ニ比スレバ常ニ大ナルヲ以テ規定ノ如キ横防撓材ヲ以テ船幅ヲ充分ニ防撓セントスルハ極メテ難キガ故ナルベシ數年前英國政府ガ其一等戰闘艦「カノーパス」號ニ就テ汽罐室支水隔壁ノ防撓力ヲ實試スルノ目的ヲ以テ一區劃内ニ水ヲ充タシタル事アリシガ此實驗ノ結果ニ因リテ近時製造中ノ戰艦ニ於ケル支水壁ノ防撓法ヲ定メタリト云ヘリ今英ノ新造一等巡洋艦ノ一ナル「サトレッヂ」號ト最近商船ノ隔壁防撓法ヲ比較スレバ第五圖ニ示ス如クニシテ英軍艦ガ實驗ニ因リテ定メタルモノト商船ガ漸然大サノ増加ニ伴ヒ變遷進歩シテ今日ニ至レルモノト大差ナキヲ知ルヲ得ベシ

支水隔壁ガ構造ニ於テ漸々進歩セシハ既ニ述フルガ如クナルガ尙其數ニ於テモ船ノ大サノ増加ニ伴ヒテ増加シ最近ノ「ロイド」規則ニ由レバ船ノ長サ三百三十呎以上四百呎未滿ノモノハ六個四百呎以上四百七十呎未滿ノモノハ七個、四百七十呎以上五百四十呎未滿ノモノハ八個五百四十呎以上六百呎未滿ノモノハ九個以上ノ支水壁ヲ設置スルコト、ナレリ

近時ノ商船ニハ雙螺旋ヲ備フルモノ多シ而シテ螺旋軸ヲ支フルニ軍艦ニアリテハ皆之ヲ船體外ニ露出シ其後端ハＡ字形支柱ヲ以テ之ヲ支持ス然ルニ商船ハ概ネ皆外板ヲ曲ケテ軸ヲ包圍シ其後端ニ達セシムルモノ多シ此二種ノ利害得失ニ就テ說ヲナスモノ尠カラズ

Ａ字形支柱ガ船ノ推進ニ大ナル低抗ヲ與フルハ英艦「アイリス」號ノ試驗ニヨリテ明白ナルモ軸ノ後端迄外板ヲ以テ包圍スルトキハ大ニ水ノ摩擦面積ヲ増加シ從テ摩擦抵抗ヲ大ナラシムルヲ以テ抵抗ノ點ニ於テハ雙方大差ナキガ如クナレトモ外板ヲ以テ包圍スルトキハ水ノ「ウーク」ヲ雙螺旋ノ中心ニ導クガ故ニ大ニ螺旋ノ能率ヲ増シ從テ速力ヲ得ルコト他ニ比シテ容易ナリト云フモノアリ然レトモ英政府ガ「テリブル」ヲ設計スルニ當テ「エキスペリメンタル、タンク」ニ於テ兩者ノ優劣ヲ比較セシモ甚シキ差違ヲ見ザリシト云フ而シテ包圍式ニ於テハ軸ヲ露出セザルヲ以テ幾分カ軸ノ損害ヲ減少シ得ルノ利ナシトセズ

大體構造ニ關スル變遷ノ概略斯ノ如シ而シテ近時特殊ノ目的ニ向テ特殊ノ構造ヲ有スル船亦尠カラズ則チ「ターレット、デッキ」及「トランク、デッキ」船ノ如キ之レナリ前者ハ千八百九十二年後者ハ九十六年ノ發明ニ係リ皆米國大湖地方ニ於テ貨物運搬ニ使用スル「ホエール、バック」形ヲ改良セルモノニ過ギス此兩者ハ全ク特殊ノ形狀ヲ有シ構造ニ於テモ通常ノ船ニ比シテ種々相違セル點多シ而シテ其利益ナリト稱スル點ハ石炭、穀類ノ積込ミニ手數ヲ要セス又其運送ニ適スト云フニアリ然レトモ斯ノ如キ特殊ノ構造ヲ攻究スルハ本題ノ目的ニアラザルヲ以テ之ヲ他日ニ讓ルモノナリ

次ニ近時ノ商船ニ於ケル推進機ノ著シキ變遷ヲ述フレハ雙螺旋ノ採用之ナリ雙螺旋ヲ用フレハ汽機及其他補助機諸軸類ノ數ヲ增スヲ以テ原價ニ於テ遙ニ單螺旋ノモノニ超エ又汽機室及車軸隧道等ニ要スル容積ヲ大ニシ機關部全體ノ重量ヲ增シ能力ハ少シク單螺旋ニ劣ルガ如ク其他經常費ニ於テモ幾分カ多額ヲ要スルニモ拘ラズ近來盛ニ雙螺旋ヲ用フルニ至リシハ主トシテ一ノ汽機若クハ車軸ノ損害ニ由リテ全ク運轉ノ自由ヲ失フガ如キコトナク大ニ船ヲ安全ナラシムルト螺旋ノ直徑ヲ小ニスルコトヲ得ルガ故ニ貨物ヲ積載セズシテ航海スル場合ニ多量ノ「バラスト」ヲ要セザルトニアリ

螺旋軸ノ損害ハ近來大ニ其數ヲ增シ「ロイド」報告ニ由レハ一昨九十八年中ニハ車軸ヲ損セシモノ一百七十三隻ニ及ヒ年々ノ難破船中之ニ起因スルモノモ決シテ尠少ナラザル可シ故ニ「ロイド」規則其他ニ於テモ大ニ車軸ノ徑ヲ增加スルニ至レリ又或ル種類若クハ或地方ノ航海業ニハ往復共ニ貨物ヲ滿載スルコト困難ナルモノ尠カラス而シテ空荷ニテ航海スルニハ必ズ螺旋ヲ適當ニ浸水セシムル爲メニ「バラスト」ヲ要スルモノナルニ多量ノ水「バラスト」ヲ積入ルノ裝置ヲナセバ載貨上及經濟上種々ノ不利益アルヲ以テ「バラスト」ノ量ヲ減ズルハ貨物船ノ設計上最必要トスル處ナリ是レ近來ノ商船ニ雙螺旋ヲ用フル所以ナリ

汽機ノ種類ハ一般ニ三聯成式ヲ用フト雖モ近來四回膨脹式ヲ用フルモノモ尠カラズ汽罐ハ通常ノ筩形ノモノニシテ水管式ヲ用ユルモノニ至リテハ其數極メテ尠ナシ之レ未タ一般航海業者社會ニ於テ充分經濟上ノ利益ヲ認メザルニ因ルカ又近來石炭ノ消費ヲ減少スルノ目的ヲ以テ「ハウデン」氏補助通風若クハ「インヂユースド、ドラフト」ヲ使用スルモノ漸然其數ヲ增加セリ而シテ兩三年來全世界ノ造船社會ヲ驚嘆セシメタル「スチーム、タービン」ノ一般商船ニ於ケル應用ニ至リテハ未ダ之ヲトスルコト難シ

斯ノ如ク汽機汽罐モ皆漸然改良ヲ加ヘタルヲ以テ大ニ其重量ヲ減シ一馬力ニ對スル重量貨物船ノ如キニアリテモ三百四五十斤ニ特種ノ輕快ナル船ニテハ二百二三十斤ニ過ギザルモノアリ又石炭消費ニ於テモ一時間一馬力ニ付一斤半ヲ下ルモノ尠カラズ

船價ハ造船業ノ繁閑材料ノ時價等ニ因リテ甚シキ差違アリト雖モ大體ニ於テハ近時造船術ノ發達及ヒ機械力ノ應用進歩セルニ伴ヒテ漸次遞減セルヲ見ル又船ノ大サノ增加ニ關シテモ總噸數五六千噸ヲ超エザル限リハ大形ノ船ハ小形ノ者ニ比シテ毎一噸ノ船價低廉ナリト雖モ六千噸ヲ超ユレバ却テ毎一噸ノ價ヲ增スト云フモノアリ之レ船ノ大サ適度以上ニ增加スルトキハ各材料ノ大サ寸法等ヲ增シ運搬工作及取著等ニ甚シキ手數ヲ要シ從テ船價ヲ增スニ至ルモノナリ是等ハ向後機械力ノ應用益發達スルニ至レバ幾分カ其憂ナキヲ得ヘシ之レ大ニ造船家ノ敏腕ヲ要スル處ナランカ

貨物船ニ於テ最モ必要ナルハ貨物積卸ノ便否ナリトス船ノ大サノ增加

セルニ從ヒ貨物ノ積卸ヲ速ニスルハ最必要ナル條項ニシテ例令如何ニ船ヲ大ニシ一時ニ多量ノ貨物ヲ運搬スルモ之レガ揚卸シニ莫大ノ時日ヲ費ストキハ寧ロ小形ノ船ヲ以テ小仕掛ニ少量ノ貨物ヲ數回ニ運搬シ短少ノ時間ニ陸揚スルノ勝レルニ加カザルノ感アリ故ニ近來ノ貨物船ニハ荷揚及荷積ヲ便且ツ速カナラシムル爲メニ種々ノ注意ト考案ヲ施セリ先ヅ揚荷機ハ近來總テ大形ノモノヲ用ヒ殊ニ綱巻(バーレル)キノ徑ヲ大ニシテ貨物巻揚ノ時間ヲ縮少シ又從來ハ一ノ荷揚機毎ニ「デリック」一本ヲ備ヘタルモ今ハ其數ヲ增シ艙口ヨリ曳揚ケテ之ヲ舷側ニ回轉シテ吊リ下ケル迄ニ要スル時間ヲ節減シ曳揚ケト吊リ下ケトニ各別ノ「デリック」ヲ備ヘ別ノ荷揚機ヲ使用シ得ルノ裝置ヲ施セリ又輕キ貨物ヲ吊リ揚クル爲メニ各檣間ノ檣索ニ四個若クハ五個ノ滑車(Cargo span. ト稱ス)ヲ連結シ同時ニ一ノ荷揚機ヲ以テ四個若クハ五個ノ貨物ヲ艙内ヨリ曳揚ケ得ルモノ多シ最完全セル貨物船ノ一例ヲ擧クレバ一隻ニシテ荷揚機十臺「デリック」三十二本ヲ備ヘタルモノアリ「デリック」モ十五噸乃至二十噸ヲ揚グルニ堪ユルモノヲ備ヘ又貨物ノ積卸ヲ便ナラシムル爲メニ艙口ヲ大ニシ大形ノ船ニテハ通常長サ二十六呎乃至三十呎幅十六呎位ノモノヲ有シ稀ニ長サ四十呎ニ達スルモノアリ

歐米各國ニ於テハ貨物船カ斯ノ如キ長大足ノ進歩ヲナセルト同時ニ各港ニ於ケル陸上ノ設備モ頗ル完全セルモノ多ク相俟テ大ニ貨物ノ陸揚積込ヲ便利急速ナラシム今世人ノ記臆ニ存スル最急速ノ陸揚ト稱セラル、一例ヲ擧グレバ英船「モナーク」號(長四百七十呎幅五十六呎、深三十四呎十吋總噸數七千三百)カ輕荷(メジュアメント、カーゴ)一萬八千五百噸ヲ陸揚シ直ニ千七百噸ノ石炭ヲ積入レ入港後第八日目ニ出帆セルガ如キハ大ニ目覺シキモノト云フベシ同船ハ艙口九個ヲ有シ荷揚機十二個「デリック」十八本ヲ備ヘタリ

荷揚機ハ通常蒸氣力ヲ用フルモノ多シト雖モ近來水力若クハ電氣力ヲ用ヒタルモノアリ其他蒸氣起重器ヲ特ニ甲板上ニ設置シテ荷揚ヲ急速ナラシメタルモノモ亦尠カラズ

次ニ「バラスト」ニ就テ少シク攻究スベシ抑モ近時ノ商船ニハ左ニ述ブル如キ理由アルヲ以テ「バラスト」ノ積方裝置等大ニ注意ヲ要スルモノナリ

第一、近來貨物船ノ形狀極メテ肥大ニシテ船底モ扁平ナルモノ多キヲ以テ空荷ノ場合ニ大ニ喫水ヲ減セルコト

第二、船幅ト喫水ノ割合ヲ增加セルヲ以テ空荷ノ時ノ喫水ヲ減スルコト

第三、船ノ大サヲ增加スルモ附屬具機械及石炭ノ重量ノ如キハ同一ノ割合ニハ增加セザルヲ以テ空荷ノ場合ニハ小形船ニ比シテ喫水極メテ淺キコト

斯ノ如ク種々ノ源因ヨリ大ニ輕喫水ヲ減少セルヲ以テ空荷ニテ航海セ

ントスルトキハ比較的多量ノ「バラスト」ヲ積載セザル可カラズ而シテ此多量ノ「バラスト」ヲ積載スル爲メニ二重底内ニ水ヲ充タスモノトセバ其容積ヲ大ニシ爲メニ載貨容積ヲ減シ又多額ノ重量ヲ底内ニ納ムルヲ以テ船ノ重心ヲ甚シク低降セシメ復原力ヲ過大ナラシメ動搖ヲ强クシ檣其他ニ損害ヲ生スルコト尠カラズ又船尾ノ喫水ヲ適當ナラシムル爲メニ特ニ後部ノ「ピーク、タンク」ニノミ水ヲ充タスノ裝置トナストキハ船體ノ振動ヲ増シ其他種々ノ故障ヲ生ズベシ故ニ近來ノ商船ニハ「ヂープ、タンク」ヲ使用セルモノ多シ「ヂープ、タンク」ニハ水「バラスト」ヲ充タサヽルトキハ通常ノ貨物ヲ積載スルヲ得ベク又「バラスト」ノ重心ヲ高ムルヲ以テ船體ノ重心ニハ甚シキ影響ヲ及サズ極メテ簡便ノ裝置ナルヲ以テ近時之ヲ再興セルモノナリ

「ヂープ、タンク」ト同一ノ目的ヲ以テ「デック、タンク」ヲ使用スルモノアリ之レ甲板間ニ「バラスト、タンク」ヲ設置セルモノニシテ常時ハ貨物ノ積載ニ使用シ得ルコト「ヂープ、タンク」ニ同シク又船ノ重心ヲ高ムルニ於テハ「ヂープ、タンク」ヨリ効力大ナリ然レトモ「ヂープ、タンク」ノ如ク多量ノ水ヲ搭載スルニ便ナラズ且ツ水ノ汲入レニハ餘分ノ力ヲ要スルヲ以テ「ヂープ、タンク」ノ如ク廣ク使用セラル、ニ至ラズ近頃竣工セル「クナード」會社ノ「イウバーニヤ」號(總噸數一萬三千餘ノ如キハ四千五百五十噸ノ水「バラスト」ヲ積載シ其内二千餘噸ハ「ヂープ、タンク」ニ搭載シ得ルモノナリ從來ハ貨物船ノ「バラスト」ノ總排水量ノ十分ノ一ヲ程度トセシモ近來ニ至リテハ「バラスト」ノ總量排水量ノ四分ノ一乃至六分ノ一ニ達セリ

「ヂープ、タンク」ハ通常一ヶ所若クハ二ヶ所ニ之ヲ設ケ汽機室ノ后部若クハ汽罐、汽機室ノ前、后ニ裝置ス然レトモ「ヂープ、タンク」内ハ水ヲ汲ミ出スモ充分ニ之ヲ乾燥スルコト難キヲ以テ歸航ニ當リテ貨物ヲ此内ニ搭載スルモ之ヲ損傷スルノ虞アリテ貨物ノ種類ニ由リテハ全ク之ヲ使用スルコト能ハサル場合尠シトセズ之レ「ヂープ、タンク」ノ欠點トスル處ナリ

近來此欠點ヲ除クノ目的ヲ以テ第六圖ニ示ス如キ「サイド、タンク」ト稱スルモノヲ中央部ノ船側ニ設ケ船側内板ヲ外板ヨリ約三呎程ノ距離ニ張リ詰メ其間ヲ水「バラスト」ノ積載ニ用フルモノアリ此方法ハ頗ル甲鐵艦ノ構造ニ類スルモノニシテ爲メニ大ニ船體ヲ堅牢ニシ船ノ安全ヲ増シ「バラスト」積入レニモ毫モ不便ヲ見ズ又「バラスト」ノ重心ノ位置モ「ヂープ、タンク」ノ場合ト大差ナシ唯此種ノ船ヲ構造裝置スルニハ「ヂープ、タンク」ニ比シテ多少困難ヲ感シ從テ船價ヲ増シ又艙内ノ容積ヲ減スルノ非難アリト雖モ「サイド、タンク」ハ主トシテ汽機汽罐室内ニ設置スルヲ以テ載貨容積ニハ大ナル影響ナク又船價ニ於テモ通常ノ特設肋骨ノ少シク複雜セルモノニシテ「ヂープ、タンク」ヲ設置セル船ニ比シテ大差ナキガ如シ現ニ此構造ヲ施セルモノ既ニ數隻ニ及ベリ

「サイド、タンク」ト同一ノ目的ヲ以テ船ノ中心線ニ中心線「タンク」ヲ使用セントスルモノアリ構造ノ難易ニ於テハ「サイド、タンク」ト大差ナシ然レトモ水「バラスト」汲出シニ要スル管ノ數ヲ減ズルト若シ「タンク」内ニ貨物ヲ搭載スル場合ニハ積入レニ便ナルト尚中心線梁柱ノ代用トシテ船體ヲ堅牢ニスルノ利アリト雖モ之レヲ實際ニ應用セシモノアルヲ聞カズ

尚其他水「バラスト」積入レニ關シ種々ノ考案設計ヲナセルモノアリト雖モ實用ニ供セシモノナシ

最後ニ商船内ノ換氣及ビ煖房裝置ニ於ケル近時ノ變遷ヲ述ブベシ

客室内ハ從來ハ舷窓及羽目板ヲ通シテ換氣セシメ時トシテハ甲板ヨリ「グースネック、ベンチレーター」若クハ「マッシユルーム、ベンチレーター」ノ類ヲ以テ通風セシモノアリシガ近來ハ商船ノ客室内ニ薄鐵板ヲ以テ製シタル「トランク」ヲ導キ室内ノ惡氣ヲ之ニ通ジ其一端ヲ汽罐圍壁内煙筒外圍板迄達セシメ汽罐室内ヨリ上騰スル熱氣ト共ニ散逸セシムルノ裝置ヲナシ尚大船ニ於テハ汽罐室ヨリ遠カレル客室内ノ換氣ヲナス爲メニ特ニ小形ノ遠心力扇風器數個ヲ据付ケ小電氣「モーター」ヲ以テ之ヲ動カシ客室内ニ導ケル「トランク」内ニ壓迫送風シ若クハ「トランク」内ヨリ惡氣ヲ拔キ出ス裝置ヲ施セルモノアリ

其他會食堂、集會室等ニハ電氣扇風器ヲ備ヘ室内ノ空氣ヲ攪動スルモノアリ之レ室内全體ノ換氣法トシテハ有効ナラサレドモ一部分ノ換氣ヲナシ温度ヲ減スルヲ得ベシ又放氣管ノ直下ニ壓迫空氣若クハ蒸氣ノ「ノッズル」ヲ備ヘ其尖端ヲ上ニ向ハシメ空氣若クハ蒸氣ノ壓力及膨脹力ニ由リテ管ヲ通ヒテ惡氣ノ散逸ヲ助クルノ裝置ヲナセルモノアリ

又艙内ノ換氣、炭庫内ノ換氣法ニハ概シテ天然通風ヲ用ヒ稀ニ人工換氣法ヲ應用スルモノアリ

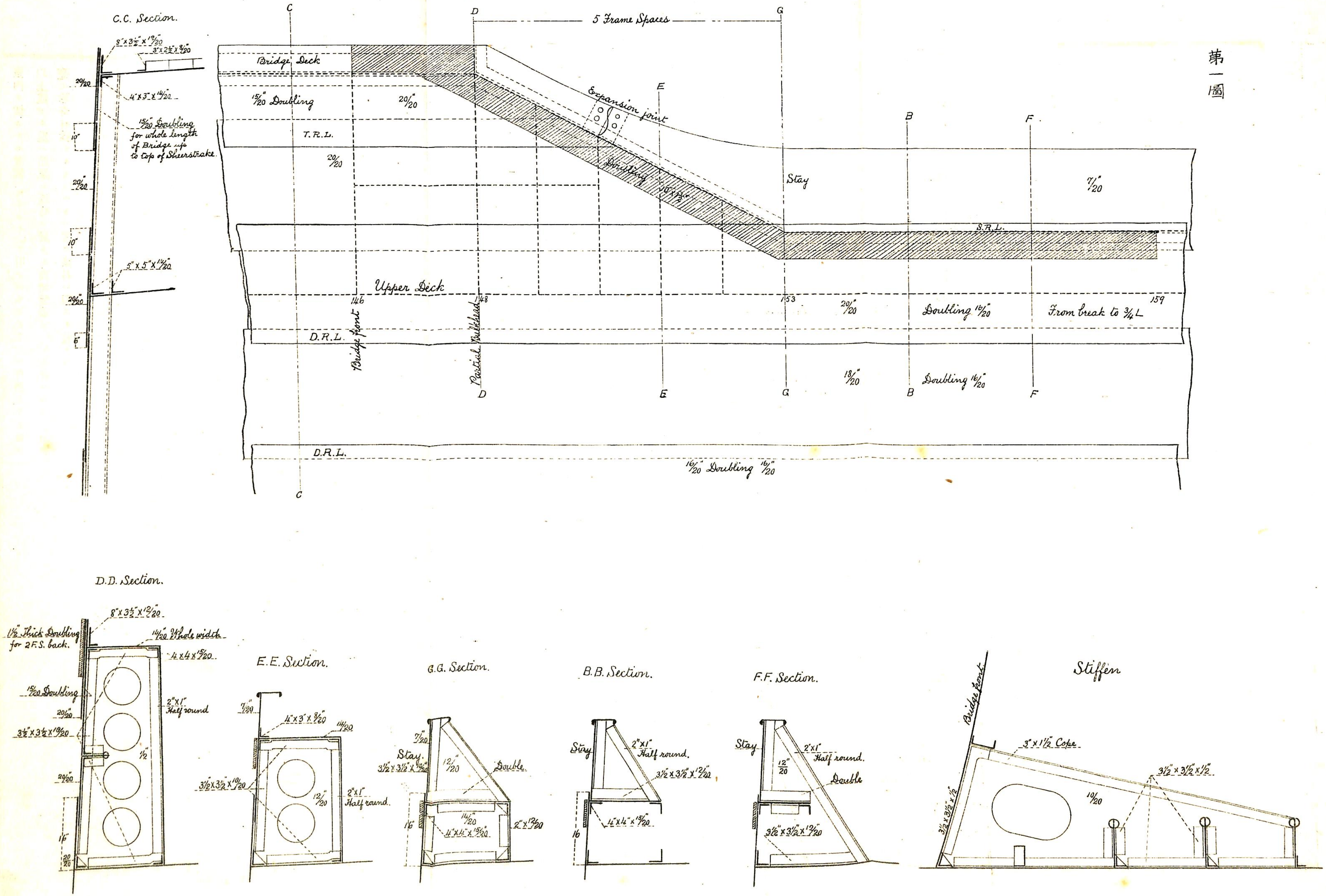
煖房ノ裝置ハ通常蒸氣ヲ用ヒ銅管ヲ以テ「ドンキー、ボイラー」ヨリ供給セル蒸氣ヲ各室ニ通シ「スチーム、レヂエーター」ヲ各室ニ備ヘテ熱ヲ發散セシメ蒸氣ハ終ニ之ヲ空氣中ニ若クハ補助冷汽器内ニ放出セシムルコト通常ノ家屋煖房裝置ト大差ナシ

近來ノ商船ニハ「サーモ、タンク」ナルモノヲ備ヘ遠心力扇風器ニ接近シテ蒸氣「ストーブ」ヲ置キ此内ニ於テ空氣ヲ熱シタル後扇風器ニ由リテ「トランク」ヲ通シテ各所ニ導クモノアリ此法ニ依ルトキハ大ナル室ノ温度ヲ上騰スルニハ極メテ有効ニシテ其一例ヲ擧グレバ通常ノ蒸氣煖器ヲ用フル時ハ室内ノ温度五度ヲ増スニ一時半乃至二時間ヲ要スル場所ニ熱氣煖房法ヲ用ヒ前者ト殆ンド同面積ノ受熱面積ヲ有スル「サーモ、タンク」ヲ以テ空氣ヲ熱シテ扇風器ニヨリテ送風スルトキハ僅々七八分間ニ同一ノ温度ニ達スルコトヲ得ベク又適當ノ時間ニ於テ瓣ノ位置ヲ轉ズレバ同一ノ扇風器ヲ以テ室内ノ換氣ヲ行フコトヲ得ベシ而シテ右ノ裝置ニ因リテ若シ蒸氣「ヒーター」管内ニ製氷機ヨリ冷水ヲ通スルトキハ空氣ヲ冷却シ夏季ニ於テハ室内ヲ寒冷ナラシムルヲ得、又

室内ヲ煖ムルニ電氣「ヒーター」ヲ用フルモノアリ大ニ有効ナリト云フ

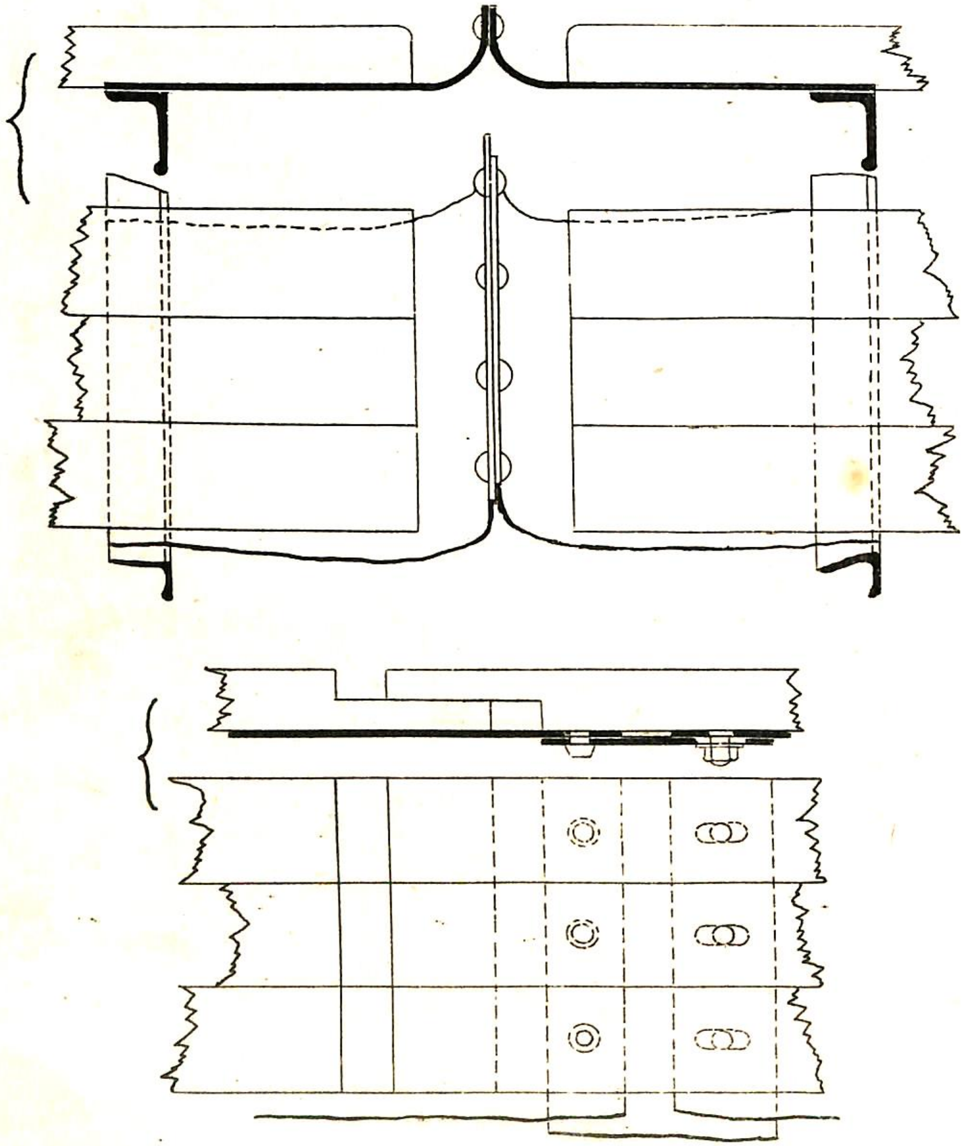
以上述ブル處ハ簡單ニ近時ニ於ケル商船變遷ノ一般ヲ記スルニ止マリ毫モ珍奇有益ナルモノナキハ深ク諸君ニ謝スル處ナリ

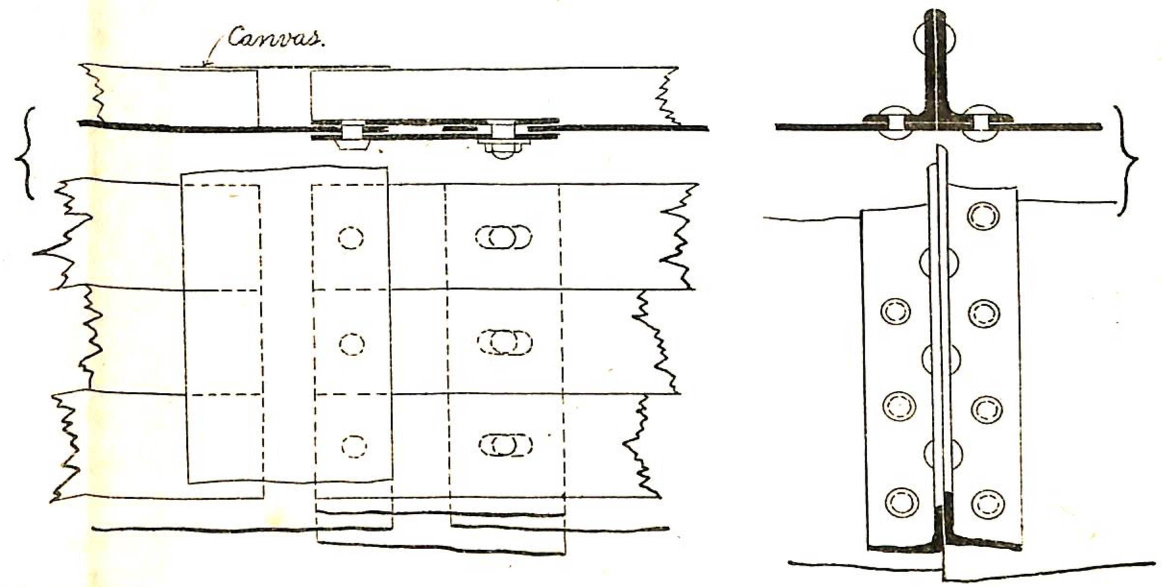
第一圖



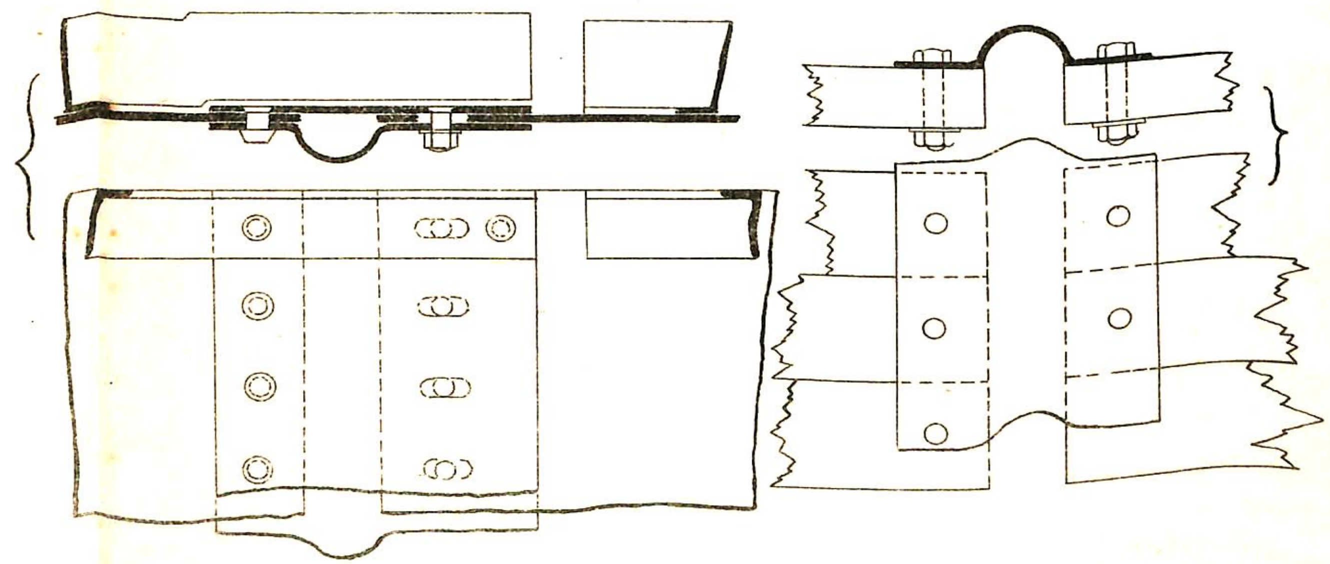
C.C. Section.
5 Frame Spaces
Bridge Deck
15/20 Doubling
20/20
Expansion joint
T.R.L.
Doubling
Stay
7/20
S.R.L.
Upper Deck
146
148
153
159
Doubling 16/20
From break to 3/4 L
Bridge front
Partial Bulkhead
D.R.L.
13/20
Doubling 16/20
16/20 Doubling 16/20
15/20 Doubling for whole length of Bridge up to top of Sheerstrake
D.D. Section.
1 1/2 Thick Doubling for 2 F.S. back.
14/20 Whole width
15/20 Doubling
2"x1" Half round
E.E. Section.
G.G. Section.
B.B. Section.
F.F. Section.
Stiffen
Stay.
Double.
2"x1" Half round.
3"x1 1/2 Cope
10/20

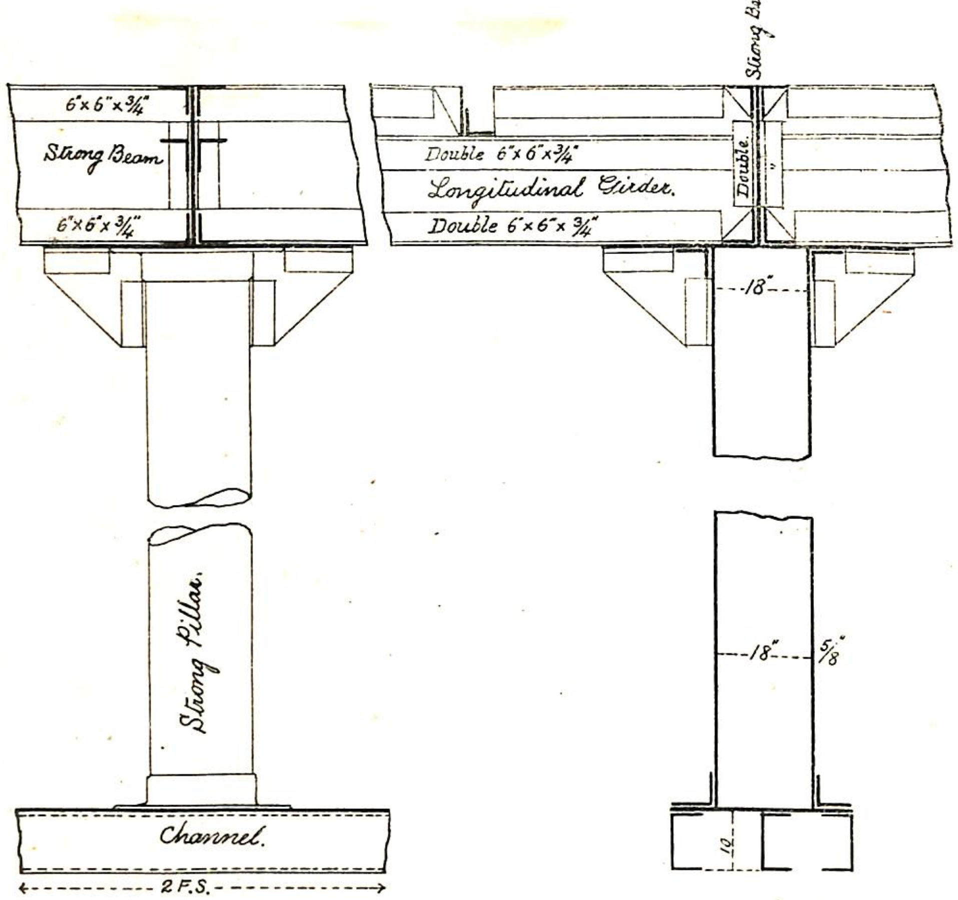
第二圖「エキスパンション、ヂョイント」



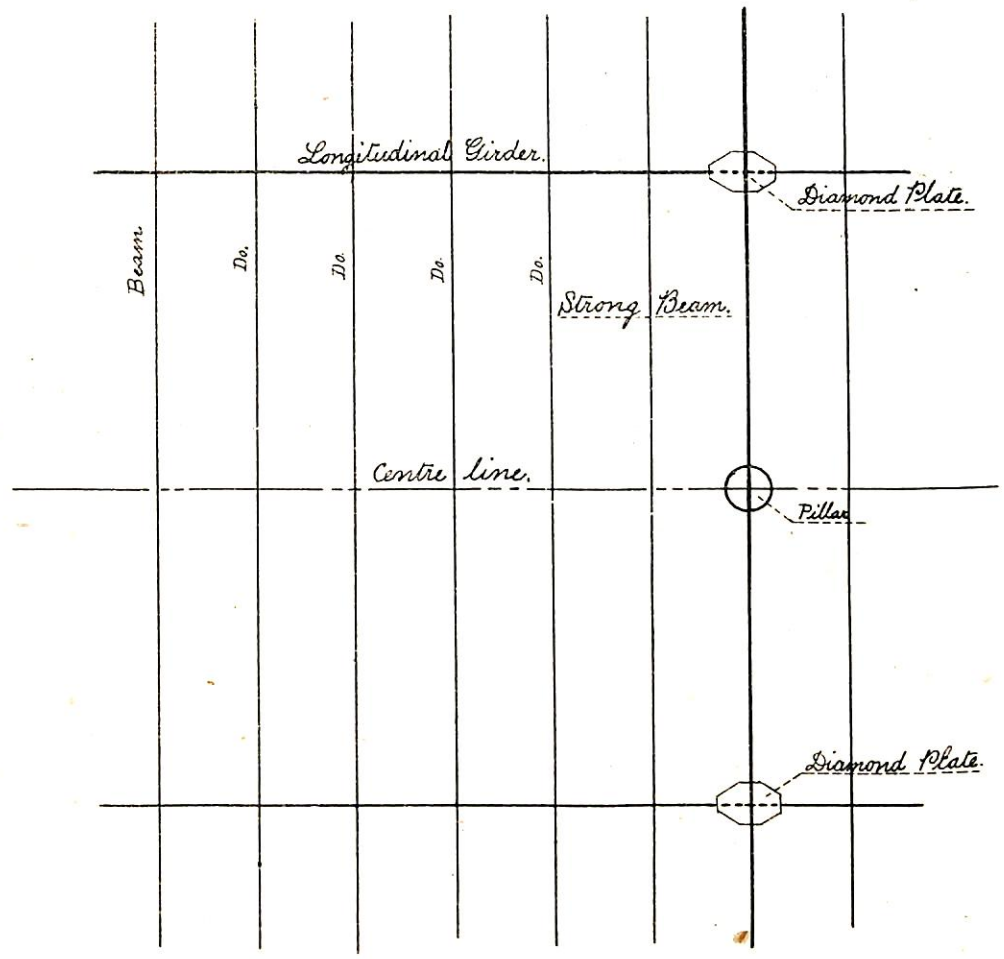


英艦「デリブル」「ボートデッキ」ニ用ヒシモノ

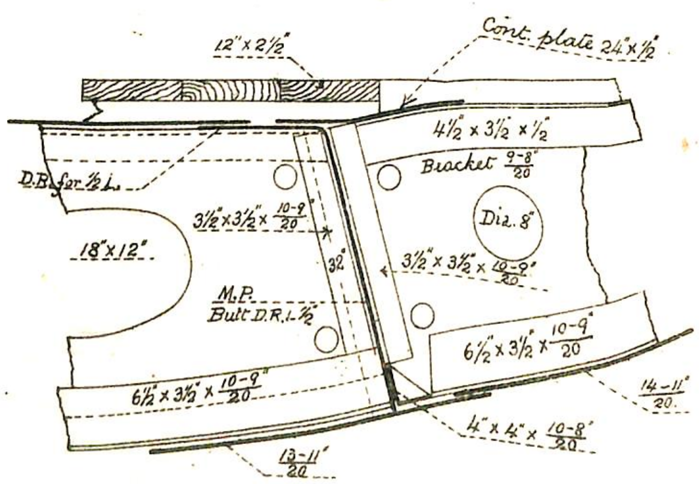


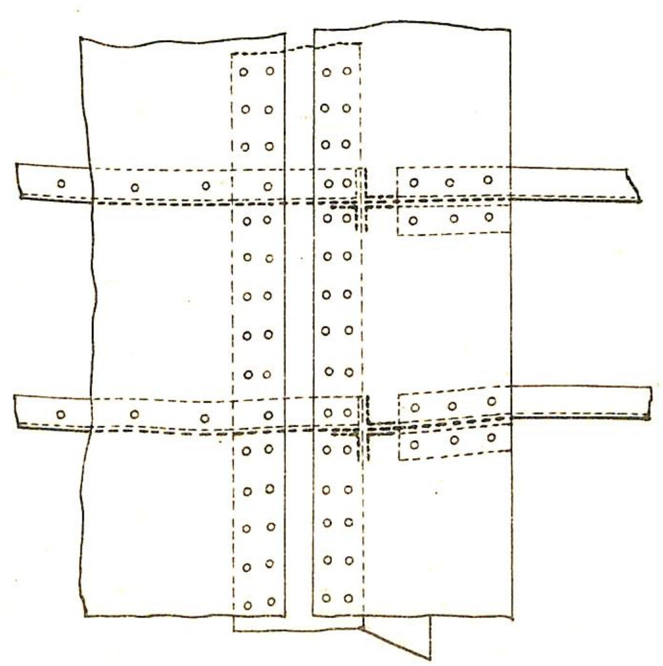

6"x6"x3/4"
Strong Beam
6"x6"x3/4"
Strong Beam.
Double 6"x6"x3/4"
Longitudinal Girder.
Double 6"x6"x3/4"
Double.
18"
Strong Pillar.
18"
5/8"
Channel.
12
2 F.S.

第三圖

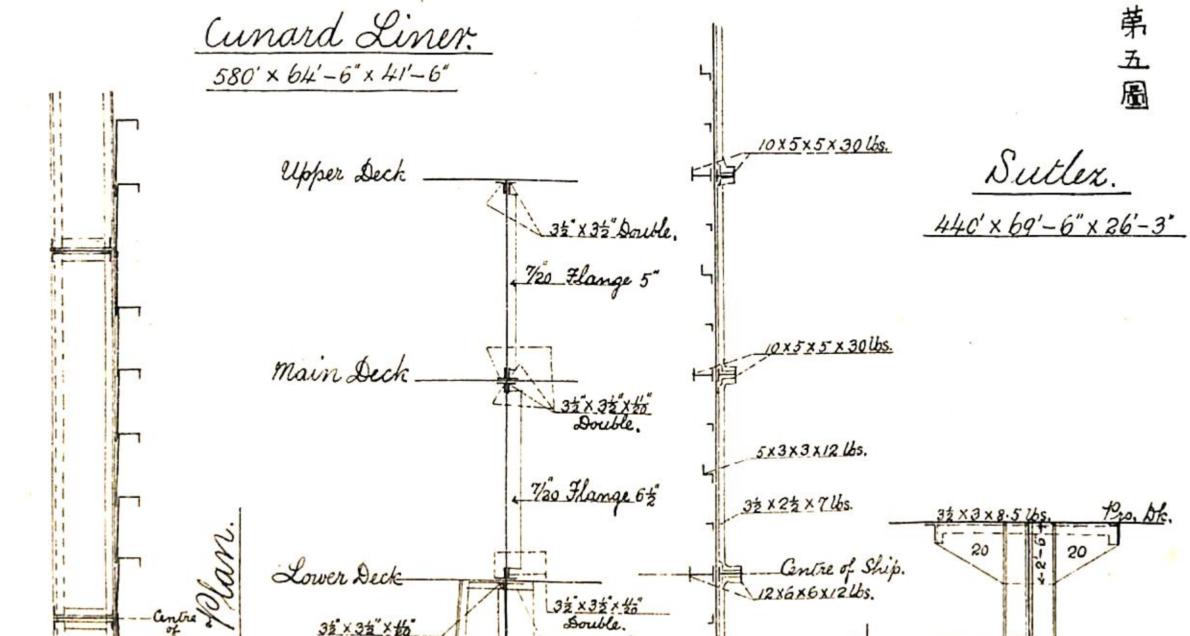

Longitudinal Girder.
Diamond Plate.
Beam
Do.
Do
Do.
Do.
Strong Beam.
Centre line.
Pillar
Diamond Plate.

第四圖

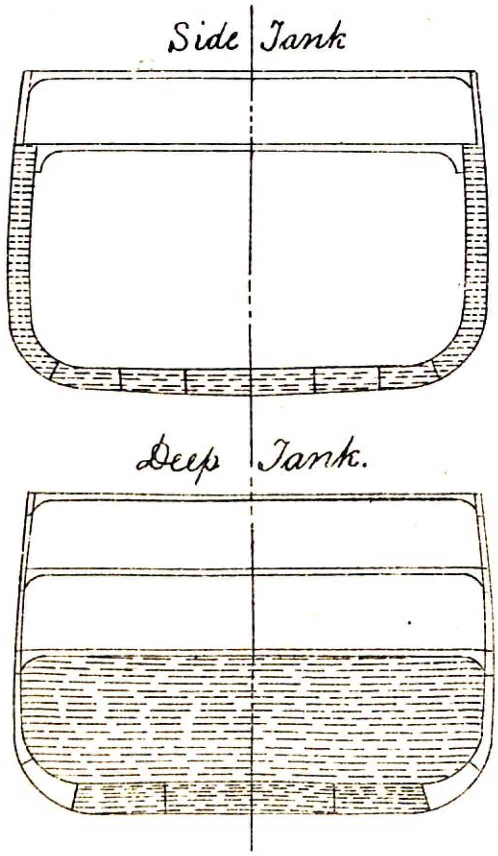

12"x2½"
Cont. plate 24"x½"
4½ x 3½ x ½
Bracket 9-8"/20
D.B. for ½ L.
Dia. 8"
3½x3½x 10-9"/20
18"x12"
32
3½"x3½"x 10-9"/20
M.P.
Butt D.R.L.½
6½ x 3½ x 10-9"/20
6½x3½"x 10-9"/20
14-11"/20.
4"x4"x 10-8"/20
13-11"/20



第五圖



Cunard Liner.
580' × 64'-6" × 41'-6"
Upper Deck
3½" x 3½" Double.
7/20 Flange 5"
Main Deck
3½" x 3½" x 11/20 Double.
7/20 Flange 6½
Lower Deck
3½" x 3½" x 11/20 Double.
3½" x 3½" x 11/20
Double Lug 3½" x 3½" x 11/20
3½" x 3½" x 11/20
10" x 3½" x 3½ x 11/20 Channel.
9/20
30"
8/20 Flange 17
3½" x 3½" x 11/20
3½" x 3½" x 11/20 Double.
Inner Bottom
2'-0"
9/20 Flange
2'-6"
Plan.
Centre of Ship.
12"
30"
3 Vertical Webs in Whole Width
10 x 5 x 5 x 30 lbs.
10 x 5 x 5 x 30 lbs.
5 x 3 x 3 x 12 lbs.
3½ x 2½ x 7 lbs.
Centre of Ship.
12 x 6 x 6 x 12 lbs.
Plan.
2'-0"
10" x 5 x 5 x 30 lbs.
8'-0"
10 x 5 x 5 x 30 lbs.
Sutlej.
440' x 69'-6" x 26'-3"
3½ x 3 x 8.5 lbs.
Pro. Dk.
20
20
2'-6"
5'-0" (about)
T Bar 5" x 4" x 12 lbs. Edge Ship.
3'-0"
20
20
Inner Bottom
3½ x 3 x 8.5 lbs.
3 x 3 x 7 lbs.
12
3'-8"
3'-8"



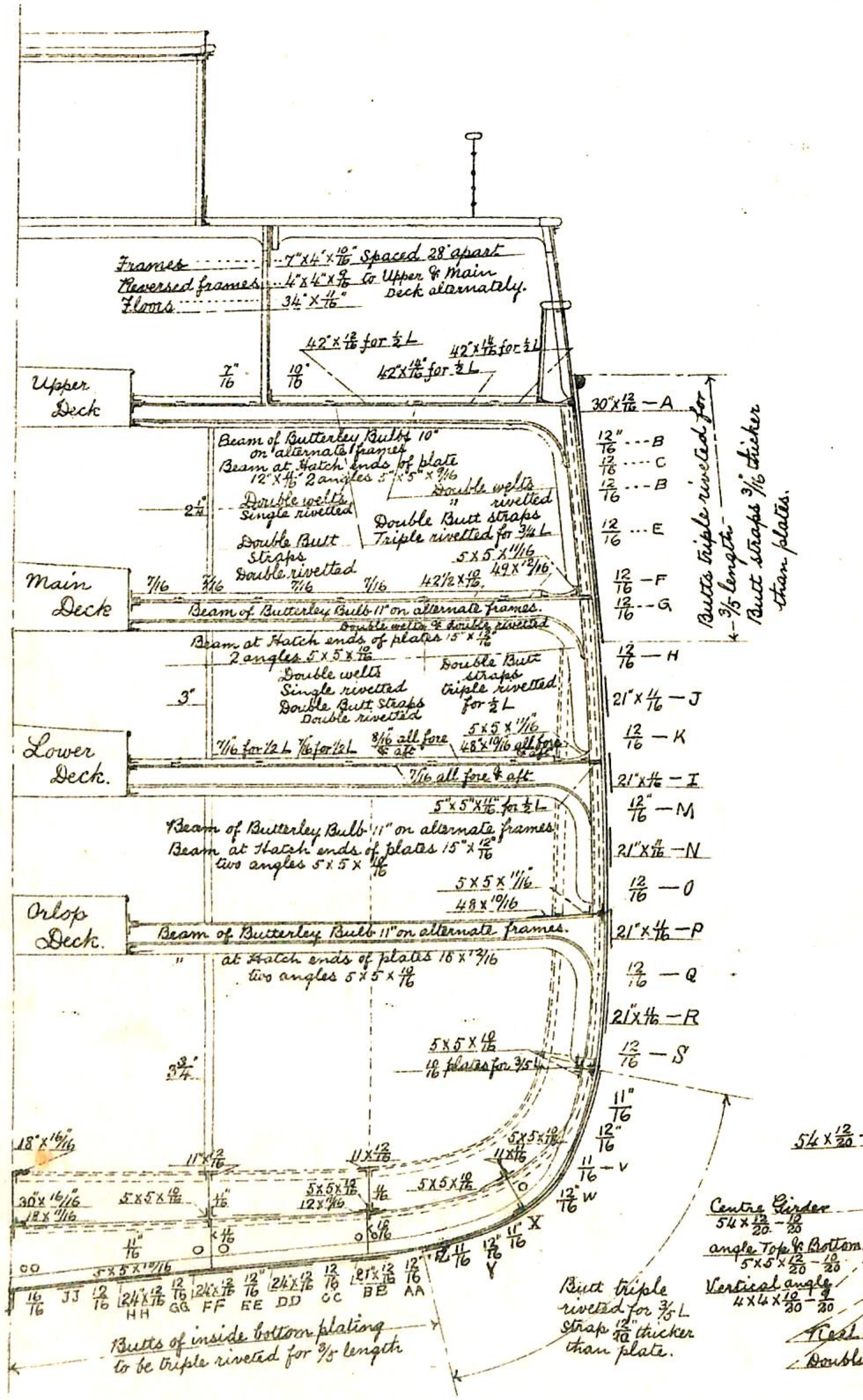
第六圖

新旧商船比較横断面

City of Rome

Principal Dimensions 560'.2 x 52'.3 x 39'-0"

(Built by Barrow Ship Building Co. 1881)



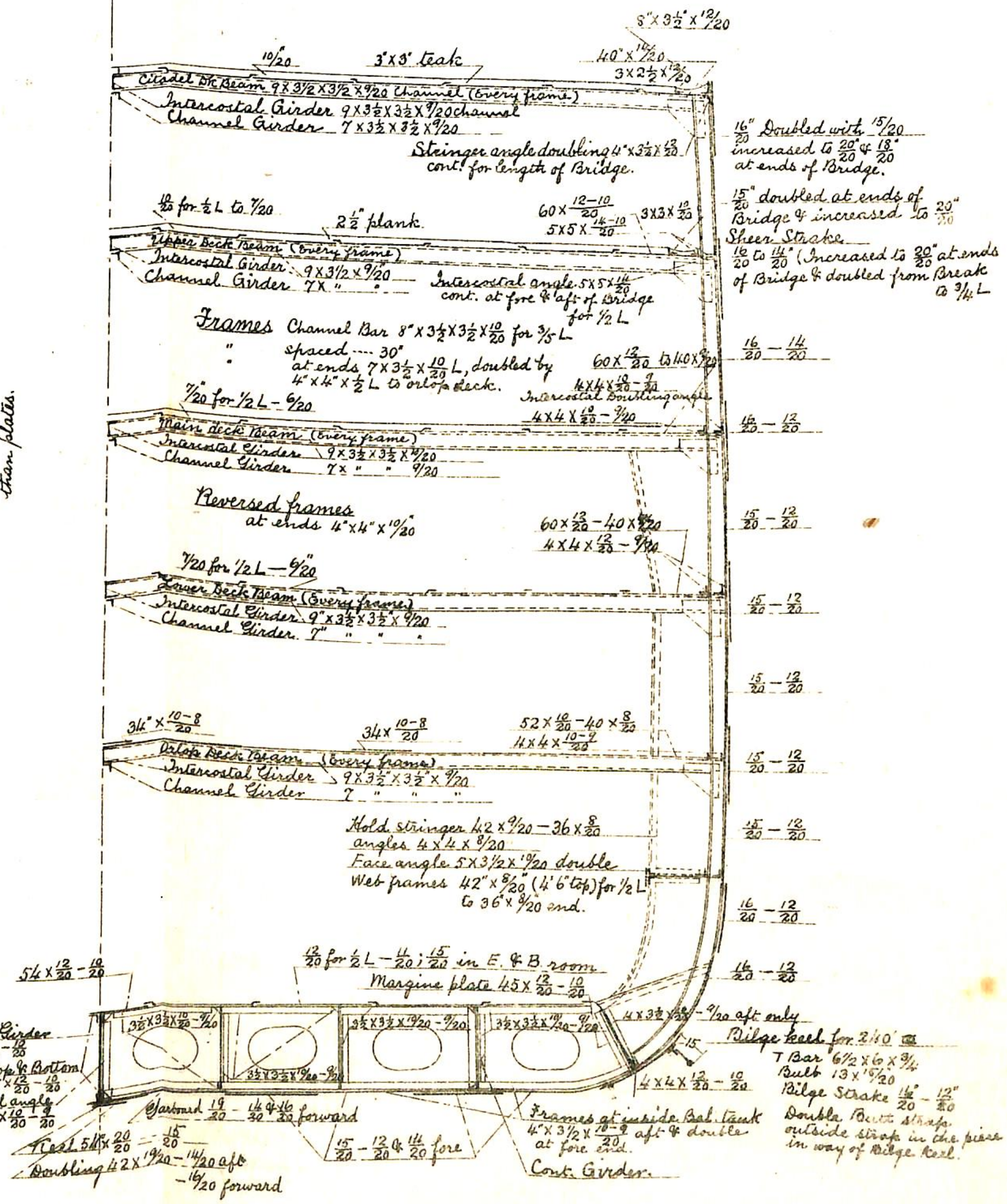
Red Star Liner

Principal Dimensions 560' x 60' x 42'-0"

1st number 134 L/D 12.9

2nd " 74761 L/B 9.29

(Built by John Brown & Co, Clyde bank. 1899-1900)



寄稿

編者曰本稿ハ北米合衆國ボストン工科大學造船科教授ピーボデー氏ヨリ會員寺野精一君ニ寄送シタルモノニシテ會員諸君ノ參考トナルベキモノト思考シ特ニ本報ニ掲載スルコトヽス

BOSTON, Oct, 3rd- 1900

Professor S. Terano

Dear Sir :

While I highly appreciate the honor of being invited to join your society of naval architects I am prevented from accepting that invitation by the fact that there are many sientific routines in America to which it is necessary for me to be a member. I shall hawever take much interest in your society and in the developement of the marine of your country.

I very much regret that Professor Miyoshi was not able to come to Boston and that I did not have the pleasure of meeting him. I send with this a copy of a paper which I have prepared on bulkheads and which has not been published I hope that you may find it available for your transaction as I shall be honored to appear in them.

I am very truly

C. C. Peabody.

STRENGTH OF BULKHEADS.

In discussing the strength of bulkheads, two distinct problems arise, namely, — the strength of the framing which supports the plating, and the strength of the plating itself, for the rigidity of the framing of large and important bulkheads is so much greater than that of the plating, that the latter can contribute little or nothing to the general or structural strength of the bulkhead. Indeed, the plating is commonly so thin that it must be treated as though it were devoid of rigidity, just as a fibrous material would be if made waterproof and subjected to pressure. Properly the framing of a bulkhead should be independently secured to the framing of the ship; when the framing of the bulkhead consists only of angle irons riveted to the plating, and cut short near the edge, the security of the bulkhead will depend on the riveting of its edge to the framing of the ship, and there is likely to be a dangerous concentration of strains at that place, more especially as the calculations of stress and strain under such conditions are difficult and uncertain.

The framing of a bulkhead should consist of Z bars or other rolled or built up forms which are adequately secured at their ends to the framing of the ship. The simplest framing will be made up of vertical bars, or other members, extending from the bottom of the hold to a deck, or from one deck to another. Such vertical members will naturally be placed over the corresponding members of the framing of the ship. For example, the frames for a longitudinal midship bulkhead will each be placed over a floor, though there need not necessarily be a bulkhead frame over every floor frame. At the present time all important steamships have double bottoms with a sufficient number of longitudinal members over which the frames for a transverse bulkhead can be placed and to which the lower ends can be adequately secured. A bulkhead is properly carried up to the main deck or to an upper deck, and consequently the upper ends of the bulkhead frames in the hold can be secured by continuing them to the top of the bulkhead. The scantling of the bulkhead frames may be reduced between the upper decks since the water pressure on a bulkhead will be less there than in the hold.

Bulkheads near the ends of large ships beyond the double bottom' or in small ships which have no double bottom, may be difficult to deal with in the manner described, since there may be no adequate means for securing the ends of the vertical bulkhead frames. It may be sufficient to stiffen such bulkheads with angle-irons, or Z bars riveted to the plating, especially as the depth of the hold in small ships is correspondingly small, and since there is likely to be an additional deck or flat worked in near the bow and stern of a large ship.

If the framing of a ship fails to give adequate security at the ends of the frames of an important bulkhead, then the framing should be changed or strengthened, to provide for the proper fastening of those frames; If this is not done it is likely that the first time a compartment at one side of the bulkhead is filled, the bulkhead frame will distort the members to which they are fastened and start serious leaks, if indeed, they do not tear away from their fastenings and cause a complete failure of the bulkhead.

In general, it will be advisable to use widely spaced, deep frames for a bulkhead whenever practicable, since the thickness of the plating is likely to be controlled by the liability to corrosion quite as much as by the requirements for strength. Again it is well, when convenient, to divide the length of a bulkhead frame in the hold by carrying a side stringer across a transverse bulkhead, or by providing a similar stringer on a longitudinal bulkhead, as the compound structure can probably be made the lighter.

It is convenient to discuss first, the strength of a vertical bulkhead frame, and to consider it to be a beam having a uniform section fixed at the ends and subjected to a load which increases uniformly from the top downward, as represented by Fig. 1. If the depth of water producing pressure at the top is h_0 and if the space between successive frames is S, both in feet, then representing the weight of a cubic foot of water by D, the load w_0 per inch of length at the top is

$$w_0 = \frac{D\ h_0\ S}{12} \qquad (1)$$

and the load por inch of length at the bottom where the depth is h_1 will be

$$w_1 = \frac{D\ h_1\ S}{12} \qquad (2^a)$$

The load at the distance X from the origin O will be

$$w = w_0 + (w_1 - w_0)\frac{X}{l} \qquad (2)$$

and the total load on the frame is

$$w=\int_0^l w\,dx=w_0 l+\frac{1}{2}(w_1-w_0)l=(w_0+w_1)\frac{l}{2} \qquad (3)$$

which might be inferred directly since the mean load per unit is

$$\frac{1}{2}(w_0+w_1).$$

Let the supporting forces at the upper and lower ends be F_0 and F_1; Which are unknown forces to be determined later. Then the shearing force at the distance x from the origin is

$$F=F_0+\int_0^x \left[w_0+(w_1-w_0)\frac{x}{l}\right]dx=F_0+w_0x+(w_1-w_0)\frac{x^2}{2l} \qquad (4)$$

If we represent the unknown bending moment at the origin by M_0, then the bending moment at the distance x from o is

$$M=M_0+\int_0^x F\,dx=M_0+\int_0^x \left[F_0+w_0x+\frac{w_1-w_0}{2l}x^2\right]dx$$

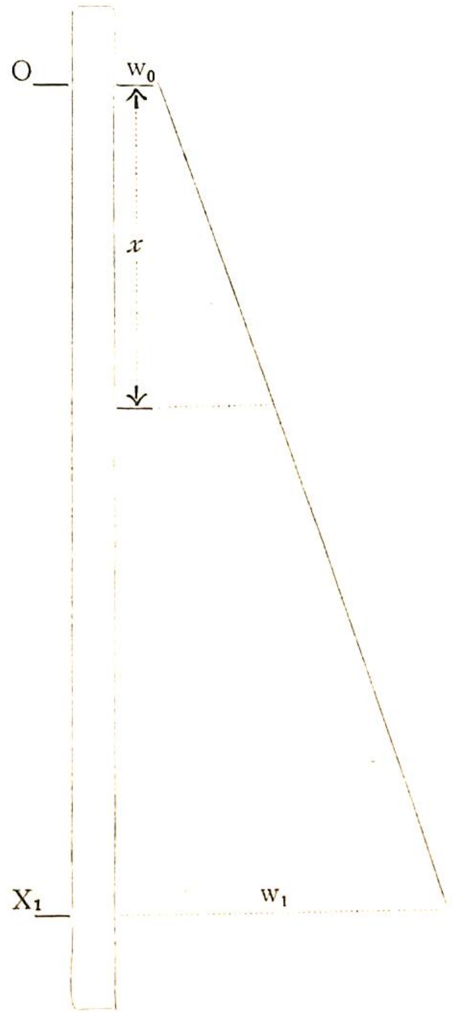
$$=M_0+F_0x+\frac{w_0}{2}x^2+\frac{w_1-w_0}{6l}x^3 \qquad (5)$$

By the theory of beams the second differential coefficient of the deflection V is

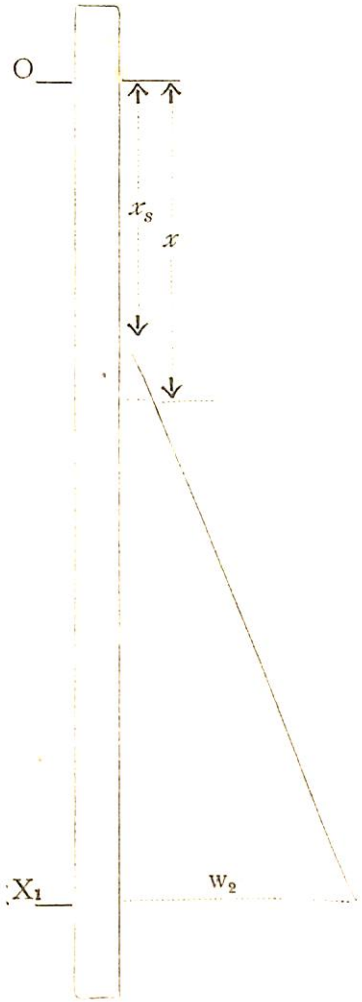
$$\frac{d^2v}{dx^2}=\frac{M}{EI}$$

where M is the bending moment, I is the moment of inertia of the section of the beam about its neutral axis, and E is the modulus of elasticity. Substituting for M from equation (5) and integrating

Fig, 1.



Fig, 2.



$$\frac{dv}{dx}=\frac{1}{EI}\int_0^x\left(M_0+F_0x+\frac{w_0}{2}x^2+\frac{w_1-w_0}{6l}\right)dx$$

$$=\frac{1}{EI}\left(M_0x+F_0\frac{x^2}{2}+\frac{w_0}{6}x^3+\frac{w_1-w_0}{24\ l}x^4\right) \qquad (10)$$

A second integration gives for the deflection

$$v=\frac{1}{EI}\int_0^x\left(M_0x+F_0\frac{x^2}{2}+\frac{w_0}{6}x^3+\frac{w_1-w_0}{24\ l}x^4\right)dx$$

$$v=\frac{1}{EI}\left(M_0\frac{x^2}{2}+F_0\frac{x^3}{6}+\frac{w_0}{24}x^4+\frac{w_1-w_0}{120\ l}x^5\right) \qquad (11)$$

But since the frame is supposed to be fixed at the lower end where $x = l$, we have at that point both the inclination $\frac{dv}{dx}$ and the deflection v equal to zero, so that equations (10) and (11) give

$$0=M_0+F_0\frac{l}{2}+\frac{w_0}{6}l^2+\frac{w_1-w_0}{24}l^2 \qquad (12)$$

$$0=M_0+F_0\frac{l}{3}+\frac{w_0}{12}l^2+\frac{w_1-w_0}{60}l^2 \qquad (13)$$

subtracting equation (13) from equation (12) we have

$$0=\frac{l}{6}F_0\frac{w_0}{12}l+\frac{w_1-w_0}{40}l \qquad (14)$$

from which

$$F_0=-\frac{l}{20}(7w_0+3w_1) \qquad (15)$$

The negative sign shows that the supporting force is opposed to the load as it of course should be.

The supporting force at the lower end of the frame is obtained by subtracting the numerical value of F_0 from the total load w by equation (3) so that

$$F_1=-\frac{l}{20}(3w_0+7w_1) \qquad (16)$$

Substituting for F_0 in equation (12) the value given by equation (15) we have

$$0=M_0-(7w_0+3w_1)\frac{l^2}{40}+\frac{w_0}{6}l^2+\frac{w_1-w_0}{24}l^2$$

$$\therefore\ M_0=\frac{1}{20}w_0l^2+\frac{1}{30}w_1l^2 \qquad (17)$$

This gives us the means of calculating M_0 numerically, so that it now becomes a known quantity, and we can then proceed to calculate the bending moment at any point by the equation (5). For example, the bending moment at the lower end of the frame will be

$$M_1=M_0+F_0l+\frac{w_0}{2}l^2+\frac{w_1-w_0}{6}l^2$$

$$=M_0+F_0l+\left(\frac{1}{3}w_0+\frac{1}{6}w_1\right)l^2 \qquad (18)$$

This will always be the greatest bending moment on the frame. The bending moment decreases for sections above the lower end and becomes zero at the point of inflection. Near the middle of the beam the bending moment again attains a maximum which can be determined by equating the first differential coefficrent of the bending moment from equation (5) to zero ; that is by making F equal to zero in equation (4) so that

$$O=F_0+w_0x_m+(w_1-w_0)\frac{x_m^2}{2l}$$

$$\text{or} \quad x_m^2+\frac{2l\ w_0}{w_1-w_0}x_m=-\frac{2l}{w_1-w_0}F_0 \qquad (19)$$

The numerical solution of this quadratic equation gives the value sf x_m which can be substituted in equation (5) to determine the correspon ding bending moment.

To find the maximum deflection of the frame, we may equate to zero the first differential coefficient of the deflection from equation (11); that is, we may equate $\frac{dv}{dx}$ to zero for equation (10) giving

$$O=M_0x_v+F_0\frac{x_v^2}{2}+\frac{w_0}{6}x_v^3+\frac{w_1-w_0}{24\ l}x_v^4$$

from which

$$x_v^3+\frac{4w_0l}{w_1-w_0}x_v^2+\frac{12\ F_0\ l}{w-w_0}x_v=\frac{24\ M_0\ l}{w_1-w_0} \qquad (20)$$

The solution of this cubic equation gives the location of the maximum deflection at x_v and the deflection can then be calculated for that point by and of equation (11).

The only adequate way of securing the ends of a bulkhead frame is to use wide and deep brackets to secure the ends to the floor and the deck, at the lower and upper ends. It now becomes a difficult question to determine what length of frame to use in calculating bending moment and deflection. One extreme will be to take only the frame between the brackets ; another extreme will be to consider that the brackets merely make up for the lack of rigidity of floors and decks and so take the entire distance between the floor and the deck. Probably something between these extremes will be fairest. In any case the greatest stress will be found at that section of the frame which is just above the lower bracket. It will be shown later that a close approximation to the deflection can be obtained by the second extreme assumption namely, that the frame under consideration, extends from deck to floor, and that the brackets only make up for lack of rigidity.

Having selected the section of the frame at which the greatest stress is likely to be found, we may find the bending moment M for that section by equation (5) and then the stress can be found in the usual way by the equation

$$M=f\frac{I}{y} \qquad (21)$$

It may happen that a compartment will not be entirely filled, or it may be desirable to determine beforehand the extent to which a compartment can be safely filled when a bulkhead is tested under water pressure ; for it is unwise to distort or give a permanent set to a bulkhead during such a test. Fig. 2 represents a bulkhead frame with the water a distance S from the upper end.

The load per inch of length at a distance X (greater than s) from the origin will now be

$$w = w_2 \frac{x-s}{1-s} \tag{22}$$

and the total load on the frame is

$$W = \frac{1}{2} w_2 (1-s) \tag{23}$$

The shearing force will be F_0 at the upper end of a bulkhead frame, as far as to the surface of the water. Below the surface of the water the shearing force will be

$$F = F_0 + \int_0^{-s} w_2 \frac{x-s}{1-s} d(x-s) = F_0 + \frac{w_2(x-s)^2}{2(1-s)} \tag{24}$$

The bending moment above the water surface will be found by adding F_0x to the bending moment M_0 over the support. Below the surface of the water the bending moment will be

$$M = M_0 + \int_0^x F_0 dx + \int_0^{x-s} \frac{w_2}{2(1-s)} (x-s)^2 d(x-s)$$

$$= M_0 + F_0 x + \frac{w_2(x-s)^3}{6(1-s)} \tag{25}$$

The slope of the beam is

$$\frac{dv}{dx} = \frac{1}{EI} \int_0^x (M_0 + F_0 x) dx + \frac{w_2}{6(1-s)} \int_0^{x-s} (x-s)^3 d(x-s)$$

$$= \frac{1}{EI} \left(M_0 x + \frac{1}{2} F_0 x^2 + \frac{w_2(x-s)^4}{24(1-s)} \right) \tag{26}$$

The deflection of the frame is

$$v = \frac{1}{EI} \int_0^x \left(M_0 x + \frac{1}{2} F_0 x^2 \right) dx + \frac{w_2}{24(1-s)} \int_0^{x-s} (x-s)^4 d(x-s)$$

$$v = \frac{1}{EI} \left(\frac{1}{2} M_0 x^2 + \frac{1}{6} F_0 x^3 + \frac{w_2(x-s)^5}{120(1-s)} \right) \tag{27}$$

But at the lower end of the frame where $x=1$, both slope and deflection are zero, so that

$$0 = M_0 1 + \frac{1}{2} F_0 1^2 + \frac{w_2(1-s)^3}{24}$$

$$0 = M_0 1 + \frac{1}{3} F_0 1^2 + \frac{w_2(1-s)^4}{60\ 1}$$

$$0 = \frac{1}{6} F_0 1^2 + w_2 \frac{(3\,1+2s)(1-s)^3}{120\ 1}$$

$$F_0 = -\frac{1}{20} w_2 \frac{(3\,1+2s)(1-s)^3}{1^3} \tag{28}$$

It will be convenient to calculate F_0 numerically, and insert it in the equations where it appears.

$$V = \frac{1}{EI} \int_0^x \left[M_0 x - \frac{1}{2} F_0 x^2 \right] dx + \frac{w_2}{24(1-s)} \int_0^{x-s} (x-s)^4 d(x-s)$$

$$V = \frac{1}{EI} \left[\frac{1}{2} M_0 x^2 - \frac{1}{6} F_0 x^3 + \frac{w_2(x-s)^5}{120(1-s)} \right] \tag{29}$$

The maximum deflection is obtained by using for x in the above equation the value obtained by equating $\frac{dv}{dx}$ to zero in equation (26), which gives

$$O = M_0 x_v - \frac{1}{2} F_0 x_v^2 + \frac{w_2 (x_v - s)^4}{24 (l - s)}$$

consequently

$$x_v^4 - 4x_v^3 s + \left[6s^2 - \frac{12}{w_2} F_0 (l - s)\right] x_v^2 + 24 \frac{(l - s)}{w_2} M_0 - 4s^3 \Big] x_v + s^4 = 0 \quad (29)$$

In discussing the strength of bulkhead plating, two cases can be distinguished. If the bulkhead is subjected to pressure, first on one side and then on the other, as may occur in an oil carrying steamer, then it appears wise to make the plating stiff enough to avoid a permanent set. But if a bulkhead (such as one aft of the engine room), will be subjected to pressure only through an sccident, it will be sufficient to make sure that the plating will not be ruptured or so distorted as to leak badly. Bulkhead plating which is always subjected to pressure on one side, as for trimming tanks, may be treated by the second method provided that the plating is thick enough to avoid an increasing amount of permanent set; but it would appear to be better to treat such plating by the first method.

It has been assumed that the framing of the bulkhead is strong enough to carry the load due to water pressure when a compartment on one side of it is flooded, and that, in general, the framing will consist of vertical members fixed at the ends, The plating between such vertical members, much like flooring or floor girders in a building, is expected only to carry the load on to the framing. Just as in calculating floors it will be sufficient to consider a horizontal strip one inch wide reaching from one frame to the next. This strip of plating may be considered to be a beam fixed at the ends and uniformly loaded. If W is the entire load on the beam, then by the ordinary theory of beams, the bending moment is greatest at the supports and is then equal to

$$M = \frac{1}{12} W l \qquad (30)$$

where l is the length of the strip in inches. The moment of resistance is

$$\frac{f I}{y}$$

as in the preceding investigation, f being the stress, I the moment of inertia of the section of the beam and y is the most strained fibre. Taking unity for the width, and t for the thickness of the strip of plating, then

$$I = \frac{1}{12} t^3 \qquad \text{and} \quad y = \frac{1}{2} t$$

so that

$$\frac{1}{12} W l = \frac{1}{6} f t^2 \qquad (31)$$

and

$$f = \frac{1}{2} \frac{W l}{t^2} \quad \text{or} \quad t = \sqrt{\frac{1}{2} \frac{W l}{f}} \qquad (32)$$

The deflection of the plating under the load W is

$$V = \frac{f l^2}{32 E y} = \frac{f l^2}{16 E t} \qquad (33)$$

where E is the modulus of elasticity, and y is the half thickness of the plate.

So long as the stress at the supports, as calculated by equation (32) does not exceed the elastic limit of the material of which the plating is made, then when the pressure is released the plate will again become flat as it was before the pressure was applied.

If the elastic limit is exceeded at the supports, the metal will begin to flow at that place, that is, the plate will begin to bend around the edge of the support. The effect of this bending is to increase the deflection so that the plate begins to bulge under the pressure of the water on it. If this is continued far enough, the plate will bulge into a cylindrical form between the frames, and will then be subjected to tension only, as is the plate of a cylindrical steam boiler. It may readily happen, however, that in the process of bulging the plate, the elastic limit has been exceeded only at the edge of the frame, and that consequently the plate will tend to flatten out when the water pressure is removed. But the plate cannot become flat at the edge of the frame for the sharp bend or kink at that place, will remain after the pressure is entirely removed. It does not appear that the plating will be injured by repeated applications of pressure on the same side; but if pressure is applied first on one side and then on the other, the plate will be bent back and forth at the edge of the frame, and will finally become hard and brittle, so that it will be likely to crack and fail at that point, more especially if corrosion is set up in the crack. Consequently it may be unwise to use this method for dealing with plating on a bulkhead which separates the compartments of an oil carrying steamer. And yet, as the angle to which the plate is bent is small, it will probably endure bending back and forth very many times before a crack is started.

A thin plate which has bulged into a cylindrical form without exceeding the elastic limit, (save at the supports), may be likened to an elastic, flexible cord, which is just long enough to reach between two supports when it is not extended by its weight. Such a cord, will of course, hang in a catenary under the influence of gravity and its elasticity. The thin plate, of course, takes a cylindrical form, because the pressure on it is uniform; the radius of the cylinder will depend on the pressure, the thickness and the elasticity of the plate, and the distance between the frames.

In order to find the relation between the hydrostatic pressure on the plate and the thickness to withstand that pressure, we may proceed in the following way. If f is the tension per square inch on the plate, and E is the modulus of elasticity, then the stretch per unit of length is $f \div E$. If the distance from an edge of a frame to the nearest edge of the next frame is S, then the stretch of the plate between two frames is $s\ f \div E$. Before the plate is bulged under pressure, it will lie flat, and its length s will form a chord reaching from frame to frame; after it is bulged it will form an arc having the length

$$s + s\frac{f}{E} = s\left(1 + \frac{f}{E}\right) \qquad (34)$$

The corresponding radius cannot be determined directly from the usual trigonometric functions, but may be obtained by interpolation in the following table, which has been calculated for the purpose. Thus an arc which aubtends an angle of 5° is 1.000317 times as long as the chord, and its radius is 11.463 times the length of the chord. The stretch is

$$0.000317\ s = s\frac{f}{E}$$

so that the tension is

$$f = 0.000317 \times E = 0.000317 \times 28{,}000{,}000 = 8900$$

pounds per square inch for medium mild steel.

By aid of the table the radius corresponding to a given working tension f can be readily determined, and then the thickness can be found by the usual equation for a thin hollow cylinder which gives

$$t = \frac{pr}{f} \qquad (35)$$

where r is the radius in inches, p is the fluid pressure in pounds per square inch, and f is the safe tensional strength.

Properties of Circular Arcs.
Chord = unity.

Angle 1	Length of Arc. 2	Length of Radius. 3	Rise of Arc. 4	Stress pounds per sq. in. 5
5°	1.000317	11.463	0.0110	8900
5° 30′	1.000384	10.421	0.0120	10800
6°	1.000457	9.554	0.0131	12800
6° 30′	1.000537	8.819	0.0142	15000
7°	1.000622	8.190	0.0153	17400
7° 30′	1.000715	7.645	0.0164	20000
8°	1.000813	7.168	0.0175	22800
8° 30′	1.000918	6.747	0.0185	25700
9°	1.001029	6.373	0.0196	28800
9° 30′	1.001145	6.038	0.0207	32100

The deflection of the plate can be found by multiplying the rise of the arc for a chord = unity by the distance between frames.

The frames for important bulkheads should always be made with a member (a Z bar or other rolled form) on each side of the plating, so that the rivets may come near the neutral axis of the section of the frame. The plate between the two members of a frame will take part in the stretching when the bulkhead is subjected to pressure, the amount and location of the stretch depending on the riveting of the frame to the plating. The effect of the stretching of this part of the plating is difficult to determine, but as it tends to decrease the radius, and consequently the stress in the plate after it has assumed a cylindrical form, we can well afford to neglect it.

To illustrate the use of this method of calculating the strength of a bulkhead, it will be applied to the longitudinal bulkhead separating the engine rooms of the U. S. Battleship "Illinois," which was tested under the direction of Naval Constructor J. J. Woodward, U. S. N. The record of this test is given in the "Transactions of the Society of Naval Architects and Marine Engineers" Vol. VI, 1898.

The frames each consisted of two members, one on each side of the plating. Each member consisted of a Z bar 6 inches deep, and with flanges 3 inches wide, weighing 15 pounds per foot of length; reinforced by an angle bar with a web 4 inches deep, and a flange 3 inches wide, and weighing 9 pounds per foot of length. Allowing for the thickness of the plating between the two members, the frames had a total depth of $12\frac{3}{4}$ inches, and had flanges 6 inches wide. The total moment of inertia about the neutral axis was 243.

The frames were secured by brackets to the floors of the double bottom at the lower end, and to the beams under the armored deck at the upper ends, by triangular brackets of 15 pound plate. The brackets on the two sides of a frame were dissimilar at both the top and the bottom, depending on the placing of piping, machinery &c.. The brakets at the bottom were 16 ½ inches wide; one was 4 feet high, and the other 15 inches high. At the top, one bracket was 20 inches deep, and 15 inches wide; the other was about 24 inches deep and 17 inches wide, but the channel bar was cut short on this side to clear the work for securing a water tight joint between the bulkhead and the armored deck. The reinforcing angle irons were carried along the outside edges of all the brarkets to stiffen them, and the deep bracket at the lower end was reinforced by an angle iron clip 3 inches by 3 inches, and weighing 7 pounds per foot.

The total length of the frames from the lower edge of the deck beams to the floors, was 22 feet 8 inches, and the head of water for the test was 24 feet above the floors.

The frames were spaced 4 feet apart; consequently the load on a frame per inch of length at the lower end was

$$w_1 = 62.4 \times 24 \times 4 \div 12 = 499.2$$

where 62.4 is the weight of a cubic foot of fresh water.

The head of water acting at the top of a frame was

$$24 - 22 - \frac{8}{12} = 1.33 \text{ feet,}$$

and the load per inch of length was

$$w_0 = 62.4 \times 1.33 \times 4 \div 12 = 27.7.$$

The total load on the beam, by equation (3) was,

$$w = (27.7 + 499.2)\frac{272}{2} = 71660,$$

From equations (15) and (16) the supporting forces at the upper and the lower ends are:

$$F_0 = -\frac{272}{20}(7 \times 27.7 + 3 \times 499.2) = -23000.$$

$$F_1 = -\frac{272}{20}(3 \times 27.7 + 7 \times 499.2) = -48660.$$

The bending moment at the top of a frame is, by equation (17)

$$M_0 = \frac{27.7 \times 272^2}{20} + \frac{499.2 \times 272^2}{30} = +1,333,600.$$

The section of maximum bending moment near the middle of the frame is found by equation (19).

$$p^2 + 2\frac{272 \times 27.7}{471.5}p = \frac{2 \times 23000 \times 272}{471.5} \quad p = 147.7 \text{ inches.}$$

At this section the bending moment is by equation (5)

$$M = 1,333,600 - 23000 \times 147.7 + \frac{27.7}{2}147.7^2$$

$$+ \frac{471.5}{6 \times 272} \times 147.7^3 = -830,000 \text{ inch pounds.}$$

The stress on the most strained fibre at this section is

$$f = \frac{M\ y}{I} = \frac{830000 \times 6 - \frac{3}{8}}{292} = 18.120 \text{ lbs. per square inch.}$$

The bending moment at the bottom of a frame, is given by equation (18):

$$M_1 = 1{,}333{,}600 - 23000 \times 272 + \left(\frac{27.7}{3} + \frac{499.2}{6}\right) 272^2$$

$$= +1{,}913{,}300$$

This is much greater than the maximum bending moment near the middle of the frame, but the moment of inertia is so great, due to the two large brackets, that the fibre stress will be relatively low.

The section just at the top of the large lower bracket is

$272 - 4 \times 12 = 224$ inches from the top of the frame; the bending moment at this section is consequently by equation (5)

$$M = 1{,}333{,}600 - 23000 \times 224 + \frac{27.7}{2} \times 224^2 + \frac{471.5}{6 \times 272} 224^3$$

$$= -5{,}152{,}000. + 5{,}276{,}000. = +124{,}000.$$

The fibre stress occasioned by this bending moment will be small in comparison with that near the middle of the frame, since the moment of inertia is the same for both sections.

It would, probably, be advisable to calculate the fibre stress at some section between the top and bottom of the lower bracket, although it is doubtful if it would be found greater than that near the middle of the frame.

The distance from the top to the section of maximum deflection, is given by equation (20):

$$p^3 + \frac{4 \times 27.7 \times 272}{471.5} p^2 - \frac{12 \times 23000 \times 272}{471.5} p + \frac{24 \times 1{,}333{,}600 \times 272}{471.5} = 0$$

$p = 142$ inches.

At this section, the deflection is, by equation (11),

$$v = \frac{142^2}{28{,}000{,}000 \times 292}\left(\frac{1{,}333{,}600}{2} - \frac{23000 \times 142}{6} + \frac{27.7 \times 142^2}{24} + \frac{471.5}{120 \times 272} 142^3\right)$$

$v = 0.449$ inches,

provided the value of E, the modulus of elasticity is taken as 28,000,000. The greatest deflection as actually measured on the frame was at a depth of 129″ and was equal to 13/16 of an inch. In order to get this deflection, the value of E must be 15,900,000.

Suppose that it is desired to limit the stress in the plating to 15000 pounds per square inch. Then, from the table of the "Properties of Circular Arcs" it appears that the radius of the plate after it is bulged into a circular form near the bottom of a frame is 8.820 times the chord. This gives for the radius

$45 \times 8.819 = 39.7$ inches.

英國軍艦進水要領

本表ハ會員近藤基樹君ヨリ寄贈セラレタルモノニシテ會員ノ參考トナルヘキモノニ付玆ニ揭載ス

Name of Ship	Mean inclination of ways per foot	Length of Ground ways in feet	Length of sliding ways in feet	Width of ways	Camber	Surface in square feet	Weight of ship in tons	Pressure per square foot in tons	Minimum Longitudinal Stability in 1000 foot tons	Water over end of ways	Pressure on Fore foot in tons
Repulse	$\frac{5}{8}''$		304	4′-7″	6″		7287	2.77		20′-4″	
Empress of India	$\frac{5}{8}''$		304	4′-3″	6″		6898	2.82		22′-0″	
Ramillies	$\frac{5}{8}''$	497	329	3′-6″	2′-4″	2762	7000	2.54	5	8′-0″	1500
Ocean	$\frac{51}{64}''$	427	310	5′-0″	9″	3100	7110	2.50	16	15′-0″	1320
Albion	$\frac{3}{4}''$	439	307	5′-0″	$8\frac{3}{4}''$	3010	6173	2.07		15′-0″	1000
Barfleur	$\frac{13}{16}''$	425	300	3′-4″	6″	1924	5200	2.70	30	9′-0″	800
Sanspareil	$\frac{5}{8}''$		245	4′-0″		1960	5746	2.92	100	15′-0″	870
Victoria	$\frac{13}{16}''$	435	265	4′-0″	9″	2120	5300	2.50			
Terrible	$\frac{17}{32}''$	576	440	3′-0″	1′-2″	2640	6650	2.32	5	8′-0″	1500
Powerful	$\frac{9}{16}''$	636	390	5′-0″	2′-10″	3900	7000	1.79	14	6′-6″	1450
Diadem	$\frac{5}{8}''$		310	4′-0″	1′-0″	2480	5400	2.25	31	7′-6″	990
Niobe	$\frac{19}{32}''$		343	5′-0″	2′-7″	3430	6300	1.84	14.8	10′-0″	1500
Blake	$\frac{3}{4}''$	420	300	3′-6″	$1\frac{1}{2}''$	2100	3550	1.75			
Royal Arthur							2630		73	11′-6″	600
Juno			255	2′-9″	2′-6″		2980	1.90			670
Dido			262	2′-6″	5″	1310	2800	2.14	8	7′-6″	440
Venus					6″	1608	2950	1.83	13	9′-0″	430
Phœnix	$\frac{9}{16}''$	336	210	1′-8″	10″		1100	1.60			

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