明治三十一年十二月刊行

（非賣品）

造船協會會報

第二號

造船史編纂趣意書

我邦世運ノ開進ニ随ヒ海運ノ運大ニ啓ケ造船ノ業頓ニ發達ス四面海洋ノ島國徒ニ自然ノ勢ノミ櫂ヲ用テ行リ帆ヲ以テ駛ルモノ今ヤ蒸氣ニ因テ航行ス形體ノ變化技術ノ進歩實ニ驚クヘキナリ能ク是等ノ沿革ヲ叙シ變遷ノ跡ヲ究ムルハ造船家ノ任ニシテ亦必要ノコトヽス本會爰ニ觀ル所アリ造船史ノ編纂ヲ企圖ス會員諸君此舉ヲ賛シ舊各藩及ヒ江湖ニ散在スル記録圖案傳説口碑ハ勿論苟クモ資料タルヘキモノアラハ廣ク之ヲ蒐メ其勞ヲ吝マス之ヲ本會ニ寄贈貸與シ又ハ報道ヲ給ラムコトヲ希望ス但太古以來ノ事歴ハ之ヲ探ル容易ノ業ニアラサルヲ以テ凡ソ我邦ニ於テ西洋形船ノ創造ヲ始元トシ今日ニ至ルノ沿革ヲ叙セントス請フ此意ヲ諒セラレンコトヲ

明治三十一年十二月

造船協會

本會記事

○第二總會

明治三十一年七月十七日午後一時五十分開會

○會長男爵赤松則良君曰　諸君今日ハ此暑サニモ拘ラズ御來會下サレマシタノハ誠ニ滿足ニ存シマス、

偖本會ハ昨年四月創立致シマシテ僅カ一年餘リニシカナリマセヌガ本會ノ趣意ガ我國ノ現狀ニ適切ナルニ由リマシテ會員モ段々增加致シマシテ本會ノ効用モ追々社會ニ弘マルコト、存シマス、夫レニツキマシテ私ノ希望ハ第一ノ總會ニ於テ述ヘテ置キマシタ通リデゴザイマシテ

今日本會ノ盛運ニ向ヒマスルハ誠ニ喜ハシキコトデゴザイマス、

今日官民トモニ造船事業ノ發達ハ著シキモノデゴザイマシテ御承知ノ通リ長崎ノ三菱造船所ニ於キマシテ本年四月十六日ニ進水致シマシタ常陸丸ノ如キ大キナ船ガ出來ル樣ニ相成リマシタ、實ニ日本デ出來マシタモノ、內デハ空前ノ大船デゴザイマシテ誠ニ名譽ノコト、存シマス、是等ハ其進步ノ著シキコトヲ證據立ルモノデアリマシテ其他ノ造船所ニ於キマシテモ追々大キナ船ガ出來ル樣ニ相成リマシヨウ、且ツ造船機械ノ工場モ船渠モ段々殖ヘマスルニ從テ造船ト造機ノ技術、又此ノ船ヲ乘廻ハシマスル航海ノ術カラシテ船ガ殖ヘマスルノハ海運ノ盛ンナルニ由ル故デアリマスカラ港灣ノ修築法等種々關係スル處ノモノガ段々發達致シマスルハ自然ノ結果デアリマスル、ガ其ノ自然ノ結果ヲ善良ノ方向ニ導キ益々好結果ヲ得ンコトハ最モ必要デアラウト存ジマス、故ニ本會ノ如キハ今日ノ時世ニ適切シマシテ最モ肝要ノモノデアリマスルニ依リ會員諸君ノ益々研究實驗ヲ重ネテ本會ノ趣意ヲ貫徹セラレンコト深ク希望スル處デゴザイマス、

偖今日ハ本會ノ規則ニ依リマシテ講演會ト總會トヲ開クコトニ為リマシテ諸君ノ御來會ヲ煩ハシマシタ、

夫レデ規則ニ依リマスルト講演會ニ引續キテ總會ヲ開クト云フコトデアリマスルガ今日ハ總會トシテ別段ニ議スベキ事モゴザイマセズ只タ會務ヲ報告スルノミデゴザイマスルニ依リ順序ヲ變更シマシテ講演ニ先ダッテ會務ヲ報告スルコトニ致シマスカラ左樣御承知ヲ願ヒマス、

昨年ノ總會ヨリ本年六月三十日ニ至リマスル間ニ會員ノ增加シマシタノハ

名譽員	一　名
贊成員	一　名
正　員	十二名
協同員	五　名
准　員	三十七名
合　計	五十六名

ノ增加デゴザイマス、而シテ名譽員ニテ佐藤鎮雄君ト坪井航三君ガ逝

造船協會年報第二號

明治三十一年十二月刊行

目次

去セラレマシタハ誠ニ悼ムベキ事デアリマシタ、ソレデ今日ノ會員ノ總數ハ

名譽員　二十六名
贊成員　十五名
正　員　六十六名
協同員　三十一名
准　員　九十七名
合　計　二百三十五名

デゴザイマス、又此ノ期間ニ於キマシテ金員物品ノ寄贈ヲ受ケマシタノハ

贊成員松田源五郎君ヨリ　金六十圓
贊成員田中市兵衛君ヨリ　金百圓
贊成員杉山孝平君ヨリ　金六十圓
贊成員梅浦精一君ヨリ　金百圓
贊成員渡邊尙君ヨリ　金六十圓
正員佐雙左仲君ヨリ　花瓶一對
工業化學會ヨリ同會ノ雜誌一部
機械學會ヨリ同會ノ會誌一部
正員山本良三郎山田鉎太郎ノ兩君ヨリ蒸氣機關學一卷

又名譽員侯爵西鄉從道君ヨリ彼様ノ書面ヲ添ヘテ金百圓寄贈セラレマシタ其書面ヲ御披露致シマス

拜啓不肖造船協會ノ會員ニ列シ光榮ノ至リニ存候抑々本會ノ成立ハ我國ノ現狀ニ於テ最モ適切緊要ナルハ勿論將來益々隆盛ナランコト國家ノ爲メ希望ニ堪ヘズ候依テ聊カ贊成ノ意ヲ表スル爲メ金百圓寄贈致候間可然御取計相成度此段申進候也

明治三十一年六月十四日

侯爵　西鄉從道

造船協會會長男爵赤松則良殿

彼様デゴザイマシテ私カラ謝狀ヲ呈シテ置キマシタ、

又昨年ノ總會ヨリ本年六月三十日マデノ金錢出納ノ現況ヲ申シマスレバ

收入額金千八十四圓十三錢七厘

內

金百二十四圓　入會金
金四百二十六圓十六錢七厘　會費
金四百八十圓　寄附金
金五十三圓九十七錢　預ケ金利子

支出額金三百十五圓二十二錢一厘

內

金一圓五錢五厘　備品費

金二圓五十九錢　消耗品費
金百二十五圓九十錢六厘　印刷費
金二十一圓七錢　郵便及配達費
金百二十六圓　報酬及手當
金三十八圓六十錢　雜費
差引殘金七百六十八圓九十一錢六厘
外ニ
金千八十三圓六十九錢八厘　前總會報告ノ殘金
合計金千八百五十二圓六十一錢四厘　現在金
内
金千七百四圓十六錢　銀行ヘ預ケ金
金百四十八圓四十五錢四厘　主計手許在金

右ガ金錢出納ノ概畧デゴザイマスガ尚ホ委シイコトハ本會ノ帳簿ニゴザイマスルデ就テ御覧ヲ願ヒマス、

之レデ會務ノ報告ガ了リマシタガ若シ御分リニナラヌコトガゴザイマスレバ御尋ヲ願ヒタウゴザイマス、是ヨリ講演會ヲ開キマス、

○講演會　講演會ニ於テ左ノ講演アリタリ

水管式汽罐　正員　宮原二郎君
頭積計ノ改良　工科大學教師ヒルハウス君
最近甲鐵戰艦及其機關官　海軍大學校教師パーチソン君
船舶ノ大小及速力ト積載量ノ關係　正員　辰巳一君
船舶製造上ノ統計ニ就テ　正員　佐雙左仲君

○金員寄附　贊成員大倉喜八郎君ヨリ金六十圓寄附セラレタリ

○評議員補缺當選　評議員關重忠君及須田利信君轉居ノ爲メ在東京評議員及在横濱横須賀評議員ニ缺員ヲ生ジタルニ付規則第三十一條ニ依リ補缺トシテ

在東京協同員近藤仙太郎君
在横須賀正員淺岡滿俊君

評議員ニ當選シタリ

○會員死亡　名譽員男爵坪井航三君ハ二月一日正員原田虎三君ハ十一月十一日死亡セラレタリ

○會員除名　准員清水定道君ハ本會會員タルノ名譽ヲ汚ス行爲アリト認メ規則第六十五條ニ依リ除名セラレタリ

○會員數　十二月一日ニ於ケル現在會員數左ノ如シ

名譽員　二十六名
贊成員　十五名
正員　六十七名
協同員　三十一名
准員　百三名
合計二百四十二名

講演

○水管式汽罐

會員　宮原二郎

諸君、此暑イノニ私ノ訥辯デ以テ愚圖々々遣ラレテハ隨分御迷惑ナ話シデスガ元來汽罐ト云フト分リ切タルヤサシイモノヽ樣ニ思ハレマスガ實際サウデナクテ其説キ明シヲスルトカ何トカ致シマスル時ニハ隨分時間ヲ取リマスカラ次ニ段々面白イ御話シヲスル方々ガ控ヘテ居ラレマスカラ一時間マデハ掛リマスマイガ三十分以上程御勘辨ヲ願ヒマス、

トコロデ私ハ之ヲ能ク下調ベヲシテ來ルガ本筋ナンデスガ實ハサツパリ夫レヲ致シマセヌデ昨日マデハ何ンダカ知ツテ居ル事ヲ當リ次第ニ言ヘバ宜シイト云フ樣ニ思テ居マシタガ今能ク考ヘテ見ルトサウハ往カヌデ大ニ繁雜シテ居リマス、ソレニ又會員諸君モ皆蒸氣ノコトニ專門ノ人ナラ夫レデ宜シウゴザイマスガ造船ノ方モアルシ又他ノ專門ノ人モアリ色々デスカラ機械專門ノ人ニ向ツテハ隨分容易イ詰ラヌ事マデモ言ハネバナリマセヌカラ其邊モ宜シク御了察ヲ願ヒマス、

汽罐ト云フモノハ御承知ノ通リ實ニ廣ク需用ノアルモノデ文明ノ利器ニシテ一々蒸氣ノ作用デアラヌモノハ一ツモナイト云フヤウナモノデ即チ其蒸氣ヲ拵ヘルモノハ汽罐デゴザイマスカラ隨分大切ナモノデ實ニ汽罐ハ工業ノ母ト申テモ宜カラウト思ヒマス、就テハ其汽罐ノコトヲ言フト云ツテモ中々長イ時間ヲ要シテ數時間御話シ致シタ處ガ深ク這入レヌ樣ナモノデゴザイマス故今日私ハ唯ダ蒸氣汽罐中ノ一種ナル水管式汽罐ト云フ問題ヲ出シテ置キマシタガ夫レニ付テ何ウ云フコトヲ言フカト言ヘバ唯ダ單ニ水管式ハ最早信用スベキモノデアツテ日本アタリニハ海軍ハ勿論商船抔ニモ今日ハ使用シテ宜シイ時期ガ來タト自分ハ確認シマス其事ニ就テ多少申上ゲタイ積リナノデゴザイマス、

夫レデ汽罐ノ沿革ヤ何カハ扨措キマシテ御承知ノ通リ段々技術ノ進歩シテ往クニ從ツテ學理ニ基イテ近世漸々ト蒸氣ノ壓力ガ高クナツテ來テ十年以前ハ六十ぱうんど位ナ壓力ノ蒸氣デ甘ンジテ居ツタモノガ今日ハ二百乃至二百五十ぱうんどト云フ位ナ勢ヒニナツテ來マシタ、處ガ今日マデ使用シ來ツタ處ノ圓筒形ナル通常ノ罐デハサウ云フ高壓力ニハ堪ヘヌヤウニナツテ來マシタ、所謂時期ガ水管式トカ云フ樣ナ完全ナ汽罐ガ世ニ出テ來ナケレバナラヌ樣ニ逼ツテ來タノデゴザイマス、尤モ此水管式汽罐ガ何時頃カラ人ニ分ツテ居タカト云フト夫レハ既ニ何十年前カラカ分ツテ居ツタノデ確カ十六世紀アタリデモ水管式汽罐ヲ作ツタコトガアリマシタ又其利益ハ能ク分ツテ居リマシタガ何故今日マデ使用シナカツタカト云フト其時分ニハ學理モ能ク行屆カナカツタラウシ且又需用ガ左樣ナ高壓力ヲ要セヌ時代デモアルシ又材料モ

良イ材料ガ其時分ニナカツタト云フ様ナコトデ其時分ハ多ク用ヒラレヌデ漸ク今日其時期ガ來タノデアリマス、ソコデ水管式汽罐ノ最モ必要ナルハ海軍デアリマシテ既ニ歐米各國デハ何レノ國デモ水管式ヲ多少使ツテ居ラヌ所ハアリマセヌ、中デモ英佛兩海軍ニアツテハ全ク水管式汽罐ヲ採用スルコトニ決定シテ仕舞ツテズン々々今日ハ行ツテ居リマス、新シイ船ハ勿論ノコト古イ船モ罐ヲ入レ換ヘル都度ズン々々新シイ水管式汽罐ヲ入レ換ヘルコトニ決定シテ居ル次第デゴイマス、偖ザット水管式ニ就テノ説明ヲ致シマスルト以前カラ發明ニナツテ特許ヲ得テ居ルモノガ澤山ゴザイマス確カ百五六十以上ノ數ガアル様ニ思ハレマス、其中デ實際實用ニナツテ居ルモノハ僅カ十五六種ノヤウニ思ハレマス、其内ノ有名ナルモノハ御承知ノ通リ佛蘭西人ノ發明シマシタべるびーゆ、英國人ノばぶこっくういるこっくす、にくろーす、やろー、のるまん、そうにくろふと、じゆたんぶる、だれすど、ぶれちんでん等デゴザイマス、其中デ汽罐ノ式ヲ概別シマスルト二タ通リアリマス即チ同シ水管デモ管ノ大キイノト小サイノトガゴザイマシテチヨット先ツ大キク分ケマスルト大管式ト小管式トニ分ケラレル、大キイ管ノ内デハ此處ニ圖ガアリマスべるびーゆ（第一圖）にくろーす（第二圖）ばぶこっくういるこっくす（第三圖）其他ふれみんぐふあがん、だれすど等夫カラ小管式デハやろー（第四圖）そうにくろふと（第五圖）のるまん、ぶれちんでん、じゆたんぶる等デアリマス其他澤山ゴザイマスガ皆似タリ寄ツタリデゴザイマス、夫レデ御承知ノナイ御方ニチヨット申上ゲテ置キタイ、水管式ト通常ノ今マデ使ツテ來タ汽罐ト何ウ云フ所ガ違ツテ居ルカト云フコトデアリマス即チ水管式ト云フノハ名ノ如ク管ノ中ニ水ガアツテ夫レカラ管ノ外ヲ煙ヤ焔ガ通ル様ニナツテ居ルシ夫レカラ蒸氣ノ壓力ノ點モ今マデノ罐デゴザイマスト管ノ外カラ掛ツテ來ルノミナラズ其他ノ部分モ概シテ外カラ壓力ガ掛ツテ中ニ火ガアル、然ルニ水管式ハ之ト全ク反對デ其構造殆ンド管デ成立ツテ居ツテ其管ノ中ニ水ガアツテ外ニ火ガアル壓力モ其中カラ達スル様ニナツテ居ル簡單ニ言ヘバ夫レガ水管式ト通常ノ罐トノ差別デゴザイマス、夫レデ今マデノ通常汽罐ト水管式トヲ簡單ニ區別シテ云フト今日用フル處ノ罐デハ管ノ中ヲ焔ガ通ル故ニ之ヲ焔管式汽罐ト云フガ相當デゴザイマス、

夫レデチヨット茲ニ極ク雜ナ圖デスケレドモ此圖ニ依ツテ説キ明シマセウト思ヒマス、此第一號並ニ第一號ノ一ノ圖ニ示シマスルべるびーゆト云フノハ今日水管式汽罐中ノ一番高評ノモノデアツテ佛蘭西デモ大層使ツテ居リマス、英吉利ノ政府デモ此特許ノ權ヲ買ツテ採用ニナツテ居ルト云フ様ナ一番數多ク世ノ實用ニナツテ居ルノハ即チ此べるびーゆデゴザイマス、圖ガ諸君ノ所ヨリ遠クテ見ヘルカ何ウカ分リマセヌガ大概ノ御方ハ御存シデゴザイマセウガ其構造ハ全ク水管デ成立テ居リマシテ一ト口ニ言ヘバ螺旋狀彈機、椅子抔ニ使ツテアル螺旋狀

ノ彈機ヲ横ニツボメタル如キ水管ノ裝置デアツテ罐ノ前ノ下部ニ給水ノ入リ來ル圓筩ガアル夫レニ今ノ水管ノ一端ガ總ニテ接合シテアリマス、給水ガ此圓筩箱ヨリ水管ニ入リ夫ヨリ火ノ作用デ以テ水管內ノ水ガ熱シテ蒸氣混合ノ水ト變シテ水管中ヲ前後往復シマシテ遂ニ上騰シテ其大部ハ蒸氣トナリマシテ上部ノ汽室ニ達シマスル、而シテ殘リノ水ハ汽室ヨリ外ニ出マシテ又々下部ニアル給水箱ニ歸リ再ヒ水管ヲ通リマシテ上騰シマス、此水管ノ一組ヲゑれめんとト申シマシテ一個ノ汽罐ニ此ノゑれめんとガ通常七ツ八ツ並ンデ居リマス、而シテ何レノゑれめんとニ付テモ皆同樣ニ水ガ此處カラ這入ツテ段々昇ルニ從ツテ蒸氣トナツテ蒸氣ト水ノ合併ノモノガトウ〳〵上ニ上ガル、此處デ蒸氣ト水ト分レテ蒸氣ハ蒸氣デ外部ヘ出、水ハ此處ニ管ガアリマシテ夫レヲ降リテ戻ツテ夫レカラ元ノ此所ノ水ノ溜リ箱ノ所ヘ來テ夫レカラ又上ヘ昇ツテ幾度モ同樣ノ働ラキヲ致シマス、此べるびーゆノ罐ハチヨツト外ノトハ大分違ツテ居テ隨分複雜ナモノデスガ第一罐內ノ水ノ分量ガ甚タ少ナフゴザイマス大概水ノアリマス水面ハ丁度罐ノ半分位即チ上カラ四番目ノ管位デシタ確カ四番目位ナ所マデ水ガ這入ツテ居リマス、然ルニ外ニハ水ガ蒸氣室ノ下部ヨリ下ノ水箱マデ一杯詰ツテ居リマス、即チ汽室ノ此處カラ這入ツテ此處カラ落チル樣ニナツテ居リマシテ罐內ノ水面以上ナル此處ニ水ガ一杯アリマスカラ其差ニ頼ツテ水ガ能ク循環ヲスル樣ニナツテ居リマス、ケレドモ此罐ニ於キマシテハ水ガ逆サマニ循環スルコトモゴザイマス夫レデスカラ此處ニハのんれたるんばるぶガ嵌ツテ居リマシテ水ガ後戻リヲセズニ是非トモ上ニ昇ツテ往ク樣ニナツテ居リマス、他ノ罐ニハ斯樣ナモノハ著イテ居リマセヌガべるびーゆニハ著イテ居リマス、夫カラ又べるびーゆ罐ノ他ノト違ツテ居ルノハ大キイ管ノ兩端ガ殘ラズ螺旋デ箱ニ嵌ツテ居リマス、サウシテ此附屬圖ノ第一號ノ二ノ如ク斯ウ云フ風ニナツテ居リマシテ中々工費ノ掛ル細工デアリマスガ汽罐全體ノ伸ヒ縮ミガ大變ニ自由ニナル且ツ管ガ極ク太イモノデスカラ各々管ノ前ニ扉ガアリマシテ此扉サヘ開ケバ中ハ自由ニ掃除モ出來ル樣ニナツテ居リマス、夫レデ此處ニアリマス此第一號圖ハ是ハ此頃ノべるびーゆノ最近ノ式デアリマシテ此式ノ起リマシタ原因ハ緣故ノアル話シデ日本支那通ヒノ佛國めしやせりまりちーむ會社ノ汽船デべるびーゆ罐ヲ備ヘタ船ガ兩三年前ニ創メテ參リマシテ日本ノ石炭ヲ焚テ見タラ煙バカリ出來テ蒸氣ガ出來兼ルト云フノデ甚タ困リ之デハ往カヌト云フノデ此最近ノ改良べるびーゆ式ガ出來マシタノデス、此式ハべるびーゆ通常ノ水管罐ヲ上下ニ二組重テタ樣ナモノデ上ノ方ハ丁度管ガ二時ト四分ノ三位ニ出來テ居リマスガ此ノ下ノ方ハ四時半位ノモノデ成立テ居リマス、即チ此ノ上ノ方ノ管列ハ給水ヲ温タメル仕掛ニナツテ居マシテぼんぷカラ來ル處ノ水ハ小管列ノ罐ノ下部ヨリ這入マシテ管列ヲ通リテ上ニ昇リマスル其途中ニテ管ノ外部ヨリ熱ヲ受ケテ遂ニ熱湯ニナリマシテ下ニ

アル本罐ニ達シマス其處ニテ本罐ノ循環水ト混シテ本罐ノ管列ヲ昇リマシテ途ニ蒸氣トナル工合ニナッテ居マシテ此式デスト火床上ニテ充分燒火セザル煙ガ上ノ小管列ノ罐ト本罐トノ間ガ燒局室ニナッテ居マスカラ其處ニテ再ヒ焰火トナリ其熱デ以テ給水ヲ温メル方法デ石炭ノ經濟ニナッテ大變宜イノデス、此罐ト今マデノ之ノ無イノトハ大變ニ蒸發力抔ガ違ヒマスカラべるびーⓛ氏ハ此方ヲ主張シテ居リマス、ソコデ之ハ全ク良クハゴザイマスガ併シ或ル大キサノ船ニ限テ使用シ得マスルモ一般ニ用フルコトハ出來兼マス、如何トナレバト云フニ大層丈ガ高イモノデスカラドンナ船ニデモ入レルト云フ譯ニハ往キマセヌ、併シ此頃デハ其方法ニ基キマシテ成ル丈ケ高サノ小サナモノヲ作リマスガ其代リニ効力モ亦減ジル樣デゴザイマス、

夫カラ此次ニにくろーすト云フ汽罐ニ就テ申上ケマス之モ矢張佛蘭西人ノ發明デアリマスガ佛蘭西海軍デハ初メふりやんト云フ巡洋艦デ九千馬力ノ船ニ採用シテ大層好結果ヲ見マシタ、其後ハ伊太利ノ船ダノ以西把尼亞ノ船ダノ夫レカラ今日佛蘭西ノ海軍デ拵ラヘテ居ル甲鐵艦二艘ト巡洋艦四五艘ヘ之ヲ用フルト云フコトデ餘程今評判ガ好クナッテ居ルノデゴザイマス、之ハ矢張べるびーⓛ同樣デ此第二圖ノ此處ハ太イ管デ唯タ違フ所ハ詰ル處水管ノ接合スル此處ガ函ノ樣ニナッテ其處ニ仕切ガアル、サウシテ外ノ方カラ水ガ這入ッテサウシテ小管ノ中カラ這入ッテ大管ノ周圍ヲ通ッテ上ガル其構造ハ大キナ管ノ中ヘ小サイ管ガ一ッ這入テ居ル裝置デアッテ此處ガ私ガ前ニ申シタ中ノ仕切ニナッテ居リマス、此處ヲ見ルト之ガ仕切ッテアッテ小サイ管ハ前ノ方ノ仕切ト通ジテ居ッテ後ロノ方ノ仕切ハ大キイ管ト通ジテ居リマス、水ガ段々降リテ來テ各々小サイ管ヘ一度這入テ夫レカラ大キイ管ヘ廻リ其處デ外部ヨリ熱ヲ受ケマスカラ蒸氣ガ出來ル其蒸氣ガ水ヲ連レテ大管ト小管ノ間ヲ昇リ此仕切ヲ上ガッテズン／＼上部ナル汽室ニ往キマシテ其汽室ヘ蒸氣ト水トノ混ッタモノガ這入テ來テ此處デ蒸氣ト水ト始メテ分離シテ蒸氣ハ汽室内上部ニ止リ水ハ下ガル、此處ノ所ヘ給水ぽんぷカラ來ル給水モ此處ニ落ル樣ニナッテ居マス、此汽罐ノ特種ノ點ハ此ノらんてるんト申シテ即チ管ノ根ノ水箱ニ接合スル所ノ仕掛ケデアリマス此らんてるんノ取付ケ樣ハ他ノ罐トハ大ヒニ違ッテ居リマス、私抔ガ五六年前ニ此罐ヲ見タ時ニハ甚タ不完全ノ樣ニ思ヒマシタ、ト言フノハ大變ニ簡畧ニ出來テ居ル、二本ノ管ガ一ッノ孔ニ嵌ッテ居ルダケデ而シテ大管ヲ其位置ニ押ヘ附ケテ居ルノハ中ニ這入テ居ル所ノ小管ノ頭部ノミニテ締メテ居ル甚タ簡單ナモノデアッテ、私ノ考ヘデハ之デハ接合部ヨリ水ガ漏ルニ違ヒ無イ、大層理屈ハ善クテモ漏ル罐ハ往カヌト云ッテ絶對的ニ反對デゴザイマシタガ論ヨリ證據ニハ四五年以前ヨリ漸々世ニ採用サレタリ又此罐ノ實地試驗ヲ二年前三週間バカリ引續キ日々見テ居リマシタガ少シモ漏ラヌ、漏ラヌ以上ハ此罐ハべるびーⓛ抔ト較ヘルト大ニ簡略デアッテ色々勝ル點ガ多クテ

中々善イモノト云フ考ヘヲ起シマシタ、今日ハ實際夫レガ善イト言フコトハ畢竟べるびーゆヲ專ラ採用シテ來リタル佛蘭西ノ海軍アタリデ種々ノ船ニ大分入レル樣ニナッテ來タノデモ明ラカデス、

夫レカラ此次ハ此第三圖ノばぶこつくういるこつくす之ハ英吉利人ノ發明デ昔シカラアルモノデアッテべるびーゆハ四十年バカリ之ハモット古イ、私ノ書生ノ時分カラ知ッテ居リマシタ其時分ハ此水管式ノ罐ハ工業會社ノ陸上用機關ニダケ使ッタガ此頃ニ至ッテ矢張リ船舶ニ使フ樣ニナッテ來マシタ、此罐ノ構造ハ前後ニ水ノ函ガアリマシテ其水ノ函ヲ幾ツモノ管デ繫イデアッテ之ノ方ハ大分前ノ二種ヨリ容易ナルモノデアリマス、是ハ此方カラ水ガ這入ッテ各々管ヲ通ッテ往クト管外ヨリ熱ヲ受ケ漸々蒸氣トナリ此方ヘ上ガッテ此處ヘ溜ル、之ハ矢張べるびーゆト同ジテ二本デ嵌ッタノガ一組ニナッテ矢張其幾組カヲ合セテ成立ツモノデ大キイ罐ヲ拵ラヘルニハ數ヲ多分ニ並ベレバ大キクナル、

夫レカラ此次ハ此第四圖ノやるろートカ此第五圖ノそうにくろふとトカ又のるまんトカじゆたんぶるトカ其他澤山アリマスガ素人ノ目カラ御覧ニナレバ皆同ジ樣ナモノデ詰ル所圓筒形ノ太鼓ガ三ツアリマシテ上ニアル一ツノ太鼓ハ蒸氣室デアッテ下ニアル二ツガ各水箱デアリマス上部ノ太鼓ト下部ノ二ツノ太鼓胴ト管ニテ繼キ著ケテアリマシテやるろー式ハ其中ノ極メテ簡略ナモノデアリマス、此第四圖ハ最近ノ形チデアリマス之ハ單ニ火ガ燃ヘテ居ルト管ガ何本カアッテ其管ノ巣ノ列ヲ通リ上ニ昇ッテ煙突ニ往キサウシテ管內ノ水ハ火ニ近イ方カラ漸々蒸氣トナリ殘リノ水ト共ニ上ニ昇ッテ蒸氣室ニ入リ其處デ水ノ分ハ火ノ遠イ方ノ管ヲ下リ又下部ノ圓筒形ノ水箱ニ戻ッテ來ル、始終斯ウ云フ風ニナッテ水ノ循環ガ好ク行屆クノデアリマス、此種類ノ小管デ成立ッテ居ル水管式汽罐ハ皆大同小異デアリマスケレドモやるろー、ぶれちんでんノ如キハ簡單ノ構造デアリマシテ其効力ハ優等デアリマス、又そうにくろふと、のるまん、じゆたんぶる等ハ管ガ大ヒニ屈曲シテ居ッテ混雜ナルモノデアリマスルノニ効力ハやるろー如キニ比スルト寧ロ劣ル樣ニ思ハレマス、そうにくろふと式トのるまん式抔ハ雙方甚タ好ク似テ居リマスガ先ッ其大差アル所ヲ言ヒマスレバ水面ノ在リ場處即チそうにくろふとノ方ハ管巣ノ上端ガ水面以上ニアリマシテのるまん式ハ水面以下ニアリマス、此圖ニテ水面ガ此位ノ所ニアルト水面以上ニ管ガ出テ居ル、のるまんノ方ハ水面以下ニナッニ居ル、やるろー、じゆたんぶる如キモ皆管ノ端ガ水面以下ニ成ッテ居リマス、

偖右等ノ數種ノ水管式ハ數多キ發明アル水管汽罐中ニテ世ニ高評ヲ博スルモノデアリマスケレドモ皆各一得一失ガアリマシテ一モ完全ト云フベキモノハゴザイマセヌ、

ソコデ此水管式ノ罐ニ就テハ私ハ五六年前來始終色々ノクダラヌ考案ヲシテ見マシテ何カ面白イ改良罐ガ出來ヌカト考ヘテ居リマシタガ漸

ク一昨年頃ニ一ツ意匠ヲ案ジ出シマシタ、夫カラ段々研究ヲシマシタリ色々シタリシテ遂ニ何カ實物トシテ役ニ立チサウナ物ヲ案出シタト認メマシタカラ夫カラ英吉利ノ其筋ニテ有名ナ人ニ見テ貰ッテ質シタ處ガマア御世辭カ何カ知リマセヌガ段々褒メテ呉マシタリ自分デモ滿足シマシタ、即チ此第六號ノ圖デアリマス、即チ此罐ノ前後ハ圓筒形ノ水箱ガアリマシテ其間ヲ筋違ノ管デ繋イデアリマス彼樣ナ簡略ナル水管罐ヲ案出シマシタ、此罐ノ最初ノ思ヒ付ト云フノハ罐ノ前後ニ水ノ壁ヲ設ケマシテ其兩壁ノ上部ハ各汽室ト致シマスサウシテ兩水壁ノ各底部ニ管ヲ接合シテ其管ヲ鋸形ニ曲ケ其管ノ上部ノ端ヲ右ノ汽室ニ接續シマス、即チ其作用ハ管中ノ水ガ火床上ノ火ニ接スルニ從ヒマシテ管内ノ水ニ熱ヲ受ケテ半バ蒸氣トナリサウシテ水ト共ニ昇ッテ汽室ニ達シマス、汽室ニ達スル時分ニハ過半蒸氣ニ化シマシテ其蒸氣ハ汽室ニ止リ水ハ又外ヨリ這入テ來ル給水ト共ニ水壁ヲ降ッテ底ニ至リマス、サウシテ其水ガ又々管ノ中ヘ這入ッテ前ノ如ク循環シマス、彼樣ニ水ガ規則正シク新陳交代シテサウシテ罐内ノ水ヲ正良ニ循環致サセマスル積リデアリマシタ、處ガ管ニ曲リ角ガアッテハ管ノ中ヲ掃除スルコトガ出來マセヌ、處デ一ツ新工風ヲ思ヒ付キマシタ、新發明ニ關スルモノハ主トシテ此點ダケノ話シナンデス、此圖ニハ管ノ數ガ一組六本ニ成ッテ居マスガ之ハ一本デモ同ジコトデス、ソコデ管ヲ一本置イテ其管ヲ曲ケテ圓筒形ヲ以テ成立テ居ル處ノ水壁ノ側ニ置キマスル代リニ此處ヘ斯ウ突込ンデ此内部ニテ帽子ヲ被セテサウシテ其管ヲ切離シテ曲リ目以上ノ管ヲ同ジ所ニ植付ケマス、サウシテ以テ曲ッタ管ト同一ノ働ラキヲサセマス、丁度管ガ此處カラ來テ曲ッテ居ッタノガ向フヘ往クト同ジコトニナリマス、此方法ニスルト其作用ハ水ガ段々蒸氣ト化ケテ上ニ昇ッテ汽室ニ入リ此所デ蒸氣ト水ハ分レテ水ハ流レ落チテ次第々々ニ底ノ方ニ往ッテ斯ウ云フ工合ニ絶ヘズ循環ヲシテ居マス、夫レデ此罐ノ私ガ特點ト思フ所ハ循環ノ水ガ誠ニ正シウゴザイマシテ水ノ上ガル方ハ上ガル一方デ即チ帽子外ノト混ラヌ、然ルニ現在世ニアル水管式ノ罐ト云フモノハ多ク此水ノ循環ガ正シク一定ノ方向ニ往クト云フ譯ニハ參リマセヌ、假令のるまんノデモそうにくろふとノデモデス、何ノ管ヲ通ッテ水ガ昇リ何ノ管ヲ通ッテ戻ルト云フコトハ判然致シマセン恐ラクハ火力ノ強弱ニ從ッテ循環ノ道モ異ナルコトデアラウト思ハレマス、サウ云フ樣ニ混雜シテ居マスレバ害ヲ受ケル所ガ出來ルトカ或ハ石炭消費上損ガナケレバナラヌ、ト言フノハ昔シカラ學理上正直ニ一樣ニ正シク循環セナケレバ罐ノ完全ヲ期シ難シト云フコトニナッテ居マス、其點カラモ良イ、夫レカラべるびーゆ抔ハ御覽ノ通リ多數ノ水管ガ殆ンド横ニ成テ居マス故水ガ一度此處ヘ來テ打付カッテ又向フヘ往ッテ又元ノ如ク後ニ歸ルト云フ譯デ餘程窄メラレテ上マデ往カナケレバナラヌ、又其管内ノ水ノ通行スル長サヲ測ルトシタラ百四五十呎ニナリマスカラ長キ管内ヲ數回無理ヲサレテ蒸

氣室ニ達スル其抵抗力ト云フモノハ中々大キナモノデアリマシテ罐ノ効力ニ大分ノ害ヲ與ヘマス、然ルニ私ノ水管罐ニ於キマシテハ大度ニ斜メニナッテヰル管カ反對ノ側ヘ一度往ッタギリデ歸ル又私ノ水管罐ノ上部ニアル管列ハべるゞーゝト同ジ樣ニ給水ヲ温メルコトニナッテ居ル、此給水ヲ温メルコトハ他ノ水管式汽罐ニモ多ク仕掛テアリマスガ私ノ考案ノ少シク異ナッテ居ル所ハ唯タ蒸氣ノ集マル所ノ汽室ノ一部分ヲ利用シテ以テ給水ヲ温メル樣ニナッテ居ル、前部汽室ノ一端カラ給水ガ這入ッテ後部ノ汽室ヘ管列ヲ通ッテ渡ッテ來ル此中ニ仕切ガアッテ又此處(コッチ)ヘ歸ッテ來テ同樣ニ幾度デモ往復ガ出來ルガ先ッ三度バカリ往復シテ後チニ後部汽室ノ底部ニ落チサウシテ徐々ニ罐ノ底筒ニ落チテ往ク樣ニナッテ居リマス、

夫レデ序デニ御話シ、テ置キマスガ英吉利ノはんふれート云フ有名ナ蒸氣會社デゴザイマスガ其處ノ社長ガ實地拵ラヘテ試驗ヲシテ見タイト云フコトヲ私ニ請求シマシタカラ勿論極ク贊成デ喜ブ所デゴザイマスカラ直ク承諾致シマシテ昨年私ガ歸朝スル少シ前ニ大急キデ拵ラヘマシタガ其計畫ヤ何カハ自分デ致シテサウシテ滿足ナルモノヲ拵ラヘタイト考ヘマシタガ向フハ私ガ承諾シタ直ク明クル日カラ私ノ貸與シマシタルホンノ粗末ナ見取圖同樣ナモノヲ以テ手本トシテ製造圖ニ取掛リマシタノデ隨分粗略ナモノデ私モ實ニ一時ハ殘念ノ樣ニ思ヒマシタガ能ク考ヘテ見マスルト斯樣ナ次第ノモノデ多少ノ結果ヲ得レバ若シ此後自分ニテ充分ニ計畫シテ滿足スルモノヲ拵ラヘレバ必ス好イ結果ヲ見ルダラウト思ヒマシテ打造ッテ任シテ置キマシタ、其工事ハ歸朝前去年ノ五月頃ニ始メマシテ八月ノ初メニ水試メシ其他ノ試驗ガ濟ンデ仕舞ッテ英國出發前ニ迫ッテ四五回實地試驗ニ立會マシタ、其結果ヤ何カヲチヨット申上ケマス、

此試驗罐ハ受熱面積ガ七百四十平方呎デゴザイマス、夫レカラ火ヲ焚ク火床面ガ二十二こんま四ゴザイマス、火床上火ヲ焚ク長サガ六呎三吋ゴザイマス其水管ハ二吋ノ管デ十六分ノ三吋ノ厚サデゴザイマシタ、夫レカラ水壓力ガ三百五十磅デ使用壓力ハ二百五十磅位ノ積リデゴアリマシタ、夫レカラ丁度私ノ出立シマシタノハ八月ノ十九日頃デゴザイマシタガ其出發前丁度五回各四時間ヅ、ノ試驗ヲシマシテ其後私ガ出立シテカラ後去年ノ十一月始マリ位マデ二十五六回ノ試驗ヲシタサウデゴザイマス、初メノ內ハ焚キ樣ガ極ク下手ダッタリ或ハ水ヲ入レル管ガ小サカッタトカ何トカ云フテ餘リ好イ成績ハ無カッタノデスガ火夫ガ漸ク上手ニナリ火ヲ焚ク工合ヲ覺ヘテ來マシテカラハ其結果ハ爰ニゴザイマス此第一表ニ示シテアル通リデ中々上等ノ成績デス、

此試驗ハ何時(イツ)デモ四時間引續キノ試驗ヲ經テ例ヘバ火燒面ノ一平方呎毎ニ一時間ニ十四斤ノ割合ニテ四時間石炭ヲ焚キマシタ時ニハ丁度石炭ノ一斤ニ就テ水ガ九、二四七磅ノ蒸發ガ出來マシタ夫レハ御承知ノ通リ實際ノ其時ノ給水ノ温度五十九度ノ結果デスカラ此蒸發力ヲ直ニ

他ノ罐ト較ヘルコトハ給水ノ温度ガ各違ヒマスカラ出來マセヌ、依テ各罐ノ成績ヲ較ベルニ給水ノ温度ヲ各二百十二度トシテ換算シテ以テ比較シマスサウスルトスツカリ分カル、ソコデ末欄ニ書イテアル通リ即チ十四斤焚クトキハ石炭消費高一斤ニ付水ノ蒸發スルコトガ十一、一八磅トナリマス、夫レカラ二十ノトキニハ十一、七三又三十斤ト云フト強壓通風ヲ用ヒマシタトキ丁度一〇、五八磅、夫レカラ四十斤ノトキハ九、一九四ト八、八ト兩方アリマシテ大分差ガゴザイマシタガ其結果ノ違ヒマスノハ火ヲ焚ク奴ガ大分素人デゴザイマシテ水管式ノ罐ノ火ノ焚キ樣ヲ心得マセヌ處カラ昔シノ圓イ罐ヲ焚イテ居ツタ癖ガツイテ居ツテ動モスルト石炭ヲ前ニ高ク積上ケテ後ロニ石炭ガ薄カツタリ致シマシタコトハ後トカラ私ヘ宛テ英國ヨリ送リ越シマシタ報告デ分リマシタガ夫故結果ノ順序ガ少シク揃ヒマセヌノデス、夫レカラ序テニ現在世ニ高評アル他ノ罐ト較ヘテ見マスト即チ此第一表ニ調製シマシタ通リデゴザイマシテべるびーゆトにくろーすトそうにくろふどト三大家ノ分ト比較シテモ優ルトモ劣ルコトハ無イ樣デゴザイマス、先ツ似タリ寄ツタリノ成績デス、假令ヘバべるびーゆ式ト較ヘテ見マスルト私ノ罐ハ粗略ナ計畫ニモ拘ラズ數年研究ニ研究ヲ積重テタルべるびーゆノ皆上ニ出テ居リマス、尤モ最近式ノゑこのまいざー附ノべるびーゆ試驗ニ比スルト其一番良イノガ十二、一六ト云フ好成績ガアリマシテ夫レニハ適ヒマセヌガ此ゑこのまいざー附ノ罐ハ一般ニ使用シ難イ罐デスカラ其比較ヲ取ルハ少シク不相當ト存ジマス、夫レカラにくろーすト比較シマスト似タリ寄ツタリノ成績デスガ先ツ私ノ方ガ少シク良イ方、夫レカラそうにくろふどノハ經濟ノ罐デナイト云フコトハ知ツテ居マスガ之ハ判然私ノ方ガ優リマス、獨リやるろー式ハ近頃ゑこのまいざー附ノべるびーゆニ負ケヌ結果ヲ見ル樣ニナツテ居リマスト云フモノハ從前ノモノニ改良ヲ加ヘマシテ新工風ヲ致シマシタカラ大層良クナツテ居リマシテ今日ノ處デハ或點ニ就テハやるろー式ノ水管汽罐ガ世界一ト私ハ存ジマス、ソコデチヨツト御願ヒ致シタイコトハ私ノ罐ガ若シ世ニ廣ク使ヘル樣ニナリマスト私ノ名譽ハ無論ノ話シデゴザイマスガ夫レハ扨置イテ先キ程申上ケタ通リ罐ノ使ヒ途ハ大層廣イモノデゴザイマスカラ若シ之ガ實際良罐ト云フコトニナリ廣ク世ニ使用サレル樣ニナリマスト我國ノ名譽ニナル譯デゴザイマスカラ何ウカシテ世ニ出ル樣ニ致シタイト切ニ希望シマスガ併シ之ヲ歐羅巴ノ實例ヲ以テ考ヘマスルト金ノ無イ人間ニハ到底出來ヌト云フコトハ判然シテ居ル、べるびーゆ式罐抔ガ大層良クナツタノハ詰ル所金ノ勢ヒデゴザイマシテ貧乏人ガ同ジコトヲ考案シタ處ガ到底用ヒラレマセヌ併シナガラ第二ノ資本トシテハ他人ノ助ケニ依テ世ニ用ヒラレルト云フコトガアリマス、私ハ金ノ方ハ迚モ〳〵夢ニモ思ヘヌ譯デスガ人ノ助ケト云フ資本ノ方ハ幸ヒ造船協會ノ諸君ハ極ク近シイ方々デゴザイマスカラ何ウカ此會員諸君ガ助力ヲシテ下サレバ多少世ニ出

ル途モアリマスカラサウ云フコトニ偏ニ懇願致シマス、ソコデ此焔管式ノ今迄ノ汽罐ト水管式ノ方ノ罐トノ雙方ノ要點ヲ比較スルト水管式ノ方ガ無論高尚ナ優等ナ點ガ澤山多イ夫レニ付テハ色々歐羅巴人ガ調ベタモノガアリマスガ皆似タリ寄タリデゴザイマス、先ツ第一ニ優等ノ點ヲ並ベルト水管式罐ハ總テ何式何種類ニモ拘ラズ高壓ノ蒸氣ニハ能ク堪ヘル様ニ出來テ居マス、夫レカラ第二ニハ蒸氣ノ出來マスルガ誠ニ早ウゴザイマス、此點ニ就テハ御承知ノ通リ今迄ノ船舶用ノ罐ハ早クテ四時間位先ツ通常六時間位モ掛リマス故ニ早急ニ船ヲ動カサウト思ヒマシテモ五六時間モ待タテハ出來ヌト云フ話シデアツテ時機ニ依テハ容易ナラヌ不利益ヲ生ジマス、然ルニ水管式ヲ採用スレバ皆半時間位デ直ク高壓力ノ蒸氣ヲ得ラレマス此點ニ就テハ非常ノ差デアツテ軍艦抔ニハ此點ハ軍略上缺クベカラザル要點デゴザイマス、又商船トテモ矢張其ノ種類ニモ寄リケリデスガ客船抔デ長イ航海デ無イチヨク〱僅カ二十里カ三十里航程ヲ往ツタリ歸ツタリスル様ナ船ニハ最モ要用デアリマセウシ又陸上ノ工業場抔デ使フニモ今迄ノ罐デアルト石炭ヲ多ク使ツテ又朝早ク火夫ヲ先キヘ出勤サシテサウシテ歸ルトキニモ二時間モ他ノ職工ヨリ居殘リヲサシテ置クト云フ様ナ譯デ大ヒニ不經濟デモアルシ不便デモアリマス、水管式中小管式ノ種類ニ依テハそうにくろふと或ハやるろー抔ハ十五分間位デ蒸氣ガ出來マスカラ實ニ便利デアル、第三番目ニハ罐ノ重量ト夫レカラ容積即チ場所ガ之ハ水管式ノ種類ニ依テ大同小異ガアリマスガ通常皆今日ノ罐ト較ヘルト大差ガアリマシテ重量抔ハ中デハ半分以上モ輕クナリマス又場所モ餘程小サクナリマス、夫レカラ四番目ニハべるびーるハ餘リサウ云フ譯ニハ往キマセヌガ他ノ水管式ナレバ大概能ク强迫通風ニ堪ヘマス中デモ小管式ノ如キハ實際强迫通風ノ如何ナル度ニモ堪ヘル様ニゴザイマス、夫レカラ第五番目ニハ蒸氣ノ力ヲ增減スルコトガ自由デ今百磅ノ壓力ヲ直チニ百五十磅ニシタイト云フト夫レハ瞬ク間ニ出來マス、夫レカラ又減スルノモ自由ニ出來ル今日ノ罐ノ樣ニ增シタモノヲ急ニ減スコトノ困難デアツテ且夫レガ爲メ石炭ノ不經濟ニナルガ如キコトハ更ニ無イ、水管式デアルトチヨツト蒸氣力ヲ下ゲ樣トスレバ火焚口ノ扉ヲ開イテ置イテモ蒸氣力ガ下ガル誠ニ容易クサウ云フコトガ出來マス、之ハ商船ヨリ軍艦ニ最モ便益ノ點デス又今日ノ罐ト比較シテ水管式ハ安全ト云フノハ即チ水ノ量ガ比較シテ大變少ナイカラ、何デモ其差ハ今記憶シテ居リマセヌガ餘程大キクゴザイマス何デモべるびーるノ罐アタリハ同馬力ノモノデ確カ十二分ノ一位ダト思ヒマス何シロ大キナ差デゴザイマス、ソコデ即チ其罐ガ破裂シマシタ處ガ多クハ管ガ一ツ破裂スル位ノコトデ其破裂シタ處ガ罐内ニ於ケル小量ノ水ガ蒸氣ト化ケテ出ルコトデスカラ多少其處ニ居ル人ハ怪我ハ致シマセウガ今日ノ如ク罐ガ破裂シテ其近邊殘ラズ人ヲ殺ストカ船ヲ破壞スルトカ云フ如キコトハ無イ其點モ確カニ水管式ノ方ガ安全、

夫レカラ船舶用トシテハ第七番目ニ船カラ汽罐ヲ出シタリ入レタリスルコトハ自由デゴザイマス今日ノハ御承知ノ通リはつちヲ毀ハシテ出サニヤア出マセヌ、水管式ナレバ船内ヘ小部分ヲ持テ往ツテ組立テラレマス夫レデナクテモ水管式ハ今日ノ罐ノ様ニ大キクナイカラはつちニ依テハ陸上デ組立ツテ夫レヲはつちヨリ其儘入レルコトモ出來ル其點モ大層都合ガ宜シウゴザイマス、夫レカラ八番目ニ修復ガ大變容易ウゴザイマスト云フノハ大概ノ水管式ヲ見ルト罐ノ搆造ノ主タルモノハ管デアルカラ管ヲ取換ヘレバ宜シイ今日ノ通常ノ罐ハ左様ナ譯ニハ參リマセンデ恐ラクハ大ヒナル部分ノ取換ヲ要シマスカラはつちヲ毀ストカ何トカセナバナラヌ大仕掛ケノコトニナリマスカラ何ウシテモ船デハ出來ヌ造船所デ造ラナケレバ出來ヌ、然ルニ水管式ハ大變容易イデスカラ船ノ中デ事ノ整ウコトガ多ウゴザイマス、夫レカラ又修復ヲスルニモ時日ガ大變ニ早ウゴザイマス、夫レカラ九番目ニ火夫ノ勞働ノ點ガ水管式ノ方ハ餘程減少スル、之ハ罐ニモ寄リケリデスガ海軍ヤ商賣船ノ大キナ罐ニナルト一ツノ罐ニふあーねすガ三ツ或ハ四ツモアル、夫等ノ火焚口ノ高サガ各々違ヒマスカラ石炭ヲ火床上ニ投ケ入レルニ火夫ノ骨ガ折レル、然ルニ水管式ノ方ハ皆火ヲ焚ク所ハ何レモ同ジ高サダカラ容易イデス、

夫レカラ今マデハ勝ル點バカリ申上ケマシタガ夫レニ反對シテ今度ハ今日ノ罐ノ方ガ良イト云フ點モ無論ナケレバナラヌ、先ツ一ツ何ノ點ガ一番今日ノ罐ニ比シ惡ルイカト云フト水ノ量ガ少ナイ其少ナイダケニ一ツ困難ノコトガアル即チ罐ヲ給水スルノガ困難、今マデノ様ナ考ヘデ給水ぽんぷヲ使用スル譯ニ往カヌ夫故今マデノ様ニ十二三分以上モ給水ヲ送ルコトヲ怠リマスルト罐内ノ水ガスツカリ無クナツテ遂ニ破裂スル懸念ガアル、夫レガ一ツノ困難、第二ニハ今マデノ罐デスト海水ヲ使ツテモ差支ガ無イ又油抔ガ多少這入ツテ居テモ其量ガ少ナケレバ先ツ差支ガ無イガ此水管式ニナルト海水ハ先ツ全ク無用ト云フ様ナ譯ニナツテ居リマス又油モ同ジク大禁物デゴザイマス油抔ハ非常ニ注意シナケレバナラヌ尤モ海水ノ點ニ付テハ水管式ノ種類ニ依リマシテハ多少使ヘルモノモアリマス、夫レカラ第三番目ニハ水管式ハ今日ノ罐ト較ヘルト數ガ多ク要ル、チヨツト一例ヲ舉ケテ申シマスト先ツ一萬四五千馬力位ヲ要スル軍艦デハ通常ノしんぐるゑんでつどノ罐ナレバ十二個位デ事ガ足リマスガ先ツべるびーゆ式水管罐ヲ入レルト致シマスト少ナクモ二十五個ヲ要シマスル次第デ實ニ二倍餘ノ罐數トナリマス、又從ツテ附屬品ノ數モ多クナリマス附屬品ノ如キハ罐ノ大小ニ關ラズ一個ノ罐ニ要ルベキモノハ附ケネバナリマセヌカラ通常ノ罐一個ニ附ケルダケノモノヲ水管式罐ノ數ノ有ル丈ケ各々附ケネバナラヌコトデアリマス、就中べるびーゆノ如キハ尚ホ特別ノ附屬品ガ附カナケレバナラヌ譯デシテ此點ニ付テハ新造費モ高クナリ且又船ノ乘員モ多クノ注意ト員數ヲ要スルコトデアリマス、第四ニハ水管式ノ種類ニ

モ依リマスガ概シテ今日ノ罐ヨリハ製造費ガ高イ其内ニモ特別ニ高イノハべるびーるデアリマス、何故之ガ高イカト云ヘバ色々特別ノモノガ要ツタリシテ高クナル上ニ管ノ代價ガ増スノデス其管ハ御承知ノ通リ各管トモ兩端ニ螺旋ヲ要シマシテ又其管ノ嵌マル所ニモ夫々螺旋ヲ幾ツモ切ラナケレバナラヌ、デスカラ其工費ハ殆ント管ノ代價ヨリ大キイ、ソコデ直段ガ高クナル殆ント通常ノ海軍用ノ罐ノチヨツト倍ト云ツテモ宜シイ、然ルニ此ばぶこつくうゐるこつくす（第三圖）ノ水管式罐ノ如キハ通常ノ罐ト同價格位ト存ジラレマス、チヨツト豫算ヲ立ツルニモ先ツ通常ノ罐ニ青銅ノ管ヲ入レタ位ナモノ、直段ト思ヘバ今マデノ私ノ調ヘタ所デハ大ナル間違ヒハナイ、やるろー式ノ如キモ極ク簡略ナル罐デスカラ安クナケレバナラヌノデスガ今デハ特許ヲ受ケテ專賣特許料ヲ取ルカラ夫レガ爲メニ高クナツテ居リマスガ之ハ安クナラナケレバナラヌ、夫レデ私ハ從來此べるびーる罐ニ對シテハ反對黨デアリマシテ能ク人ニ笑ハレル位デゴザイマス、チヨツト私ガ自分ノ罐ヲべるびーるノ罐ト比較シテ少シモ劣ル點ガ無キヤト信シマス例ヘバ第一ニ罐ノ代價ハ私ノハ實際半分以上安イ之ハ確カニ安イノデス、夫レカラ第二ニハ强迫通風ニ能ク堪ヘマス即チ英國ノはんふれー會社デ私ノ罐ヲ實驗シテ同社員モ强迫通風ニ能ク堪ヘルコトヲ斷言致シマシタ、べるびーるノ如キハ先ツ堪ヘヌトシテアル此點モ宜シイ、夫レカラ製造上ニ關シマシテハべるびーる罐ハ特別ナ道具デ特別ナ職人デ叮嚀ニ造ラナケレバナラヌ、然ルニ私ノ罐ハ何處ノ工場デモ圖サヘ見レバ分カル唯タ管ヲ少シ曲ゲサヘスレバ宜シイ唯タ通常ノ製罐所ニテ普通ノ道具ト職工デ極ク容易ク出來テ、又罐ノ取扱上ニモ大層宜シイ、ト云フノハ私ノハ水ヲ較ベテ見ルト餘程多量デアル、夫レデスカラ給水ノ困難ハ無イ、實驗シタ罐モ普通ノ給水器ヲ採用シテ使ツタノデスガ何ノ不都合モナシニ誠ニ旨ク往キマシタ、べるびーるノ方デハべるびーる發明ノ特別給水器ヲ使ハナケレバ往カヌ、夫レカラ水ト蒸氣ノ循環ト云フ點ニ付テハべるびーるノハ先刻申シタ通リ隨分無理ヲ遣ルノデスガ私ノハ極ク天然ニ往ツテ居リマスカラ自然効力ガ宜シクナラナケレバナラヌ譯デゴザイマス、トコロデ石炭經濟ノ點ニ於キマシテモ今ノゑこのまいざー附ノモノト比較スルト英吉利デ實驗シタ罐デハ少シ劣ル結果デゴザイマスルガ夫レハ前ニ申シタ通リ極ク粗雜ニ出來テ居リ又創メテノ罐デシテ其試驗ニ較ベテハ餘リ公平ト云フ譯ニハ往カヌダラウト思ヒマス、而シテゑこのまいざーノ附イテ居ルモノハ丈ノ高イモノデ或ル船ニハ用ヒラレルガ一般ニハ用ヒラレヌ、然ルニ通常ノべるびーるト比較スルト私ノ方ガ良ウゴザイマスカラ是カラ後ニ造ル罐ハ計畫製造共旨ク造ツタラ上等ノ結果ヲ得ルコト、信シマス、夫レカラべるびーるノ罐ト比較スルト之ハ特別ノぽんぷモ其他ノモノモ要リマセヌ通常ノ罐ノ通リデ宜シイ、此べるびーるニハ色々をーとまちっくふぃーどれぎゅれーたートカ何トカ彼トカ幾ツモ特

別ノ機械ガ要ル、夫レカラ管ヲ取換ヘタリ掃除ヲスルノニべるびーゆノハ一本ニ付テ一ツ宛孔ガ付イテ居ルガ私ノハ其孔ノ數ガ餘程少ナイ私ノ罐ハ其孔ノ徑ガ大概二吋、彼ノハ四吋、而シテ私ノハ一組六本アツテ一ツノ孔カラ六本出這入リスル故結局べるびーゆニ比シ三分ノ一私ノ方ノ孔ノ數ガ少ナクテ濟ミマス、此點ハ御承知ノ通リ管ヲ取換ヘタリ掃除ヲシタリスルニ取扱上大變都合ノ宜イ譯デゴザイマス、夫レデ構造ノ工合ガチヨツト違ヒ循環ノ方法ガ違ツタリシマスガ私ノハ實際遣ツテ見マセネバ判然申上ケラレマセヌガ唯タ學理上デ思フニハ海水ヲ使ツテモ差シタル不都合ハ無キヤト思ヒマス、管内ノ水ガ循環サヘ迅速ニ遣リマスルト海水ヨリ生スルすけーるヤ何カハ溜ラヌト云フコトハ分ツテ居ル、溜ルコトハ溜マルガ水ノ循環ノ激シクナキ罐ノ部分ニ澱ミ溜ルト云フコトニ實驗上分ツテ來マシタ、やるろー社ニ於テモ既ニやるろー式ノ罐ニ私ノ勸告ニ依リ海水ヲ使ツテ試驗ヲシマシタガ其結果ハ宜シウゴザイマシテ時機ニ依テハ多少ノ海水ヲ使用シテモ害ハ無イト申スコトデゴザイマス、此點ニ付テモ私ノハ純粹ニ循環スル路ガ判然致シテ居リ且ツ管内ノ水ノ速力ガ迅速デアリマスカラ恐ラク管内ニすけーるガ溜マル理ガ少ナクテ溜マルノハ水ノ運動ノ鈍キ水鼓ナル前後圓筒内就中一番底ノ圓筒内ニ多分ニ溜マル筈デスべるびーゆト比較スルト實ニ同日ノ論ニ非ラズト存シマス、夫レカラ又同シ馬力ニ對シマシテ私ノ罐ナレバ罐ノ數ガべるびーゆヨリモズツト少ナクテ宜シイ、夫レガ爲メ附屬品モ少ナク又取扱ノ人數モ減セラレマス、夫レカラ其次ハ罐内ノ水量ニ付マシテハ私ノ罐ノ方ハ水ガ多イカラ給水法ハ誠ニ容易デゴザイマシテ工合ガ宜シイ其代リニハべるびーゆト較ヘテ無難ノ一點ニ付テハ少シク劣ル理デス、夫レハ水ノ量ガ多イカラシテ若シ管ガ破裂スル時ニハ蒸氣ノ放射スル量ガ多イ故ニべるびーゆヨリハ困難ガ多イ道理デスガ今日使用ノ通常汽罐ノ水量ヨリハ猶ホ遙カニ少量デアリマスカラ猶他ノ水管式ト同樣安全ノ罐デアリマス、處デ段々時カ迫ツテ來マスカラ最早結末ニ至ラナケレバナリマセヌガ詰ル所先程申シタ樣ニ通常ノ罐ト水管式ノ罐ト比較シマスルト水管式ノ方ガ大分利益ノ點ガ多イ、夫レカラ又今ヤ蒸氣ノ壓力ヲ段々向ホ高メテ往カナケレバナラヌ時期ニ接シテ居リマスカラ水管式ノ方ガ利益ガアルト認メタル上ハ軍艦ハ申スニ及ハズ商船ニモ可成ダケ早ク採用ナリタイ、歐米ニテハ今日著々其歩ヲ進メテ居リマスカラ何レ其時期ガ日本ニモ來ルデアリマセウガ國家ノ經濟ニ關スルコトデアルカラ我工業社會ニハ早ク此邊ニ注意シテ貰イタイノデス、

茲ニ水管式汽罐ヲ採用シテ利益ナルコトヲ一目瞭然ニ御了解ニナル樣ニ第二表ナルモノヲ掲ケマシタ、之ハ有名ナルしーどん氏ガ拵ラヘマシタモノヲ種ニシ調製シマシタ即チ通常ノ圓筒ノ汽罐ト各種ノ水管式汽罐トヲ同一ノ艙ニテ同馬力ノモノニ入レタルモノトシテ算出シタルモノデゴザイマシテ比較上物ノ偏頗ナク誠ニ公平ニ出來テ居リマス、

此表中ノ第一第二欄内ノ分ガ通常ノ圓筒形ノ汽罐、第三ガべるびーゆ、第四ガばぶこっくういるこっくす、第五ガはうでん式、第六ガそうにくろふと、第七ニ私ノ水管汽罐ヲ聊カ參考ノ爲メニ加ヘテ置キマシタ、やるろー、のるまん、ぶれちんでん等ナル小管式水管汽罐ハ重量容積其他ノ要點ハそうにくろふとト大同小異デアリマスカラ第五欄ノ事項ヲ適用シテ差シタル過チナキコトニ考ヘラレマス、第五欄ニアルはうでん式ハ御承知ノ通リ特別ノ強壓通風ヲ圓筒形ニ仕込ンダモノデスガ茲ニアリマス此表ノ成績ハ餘リ好過キテ怪シイカト思ハレマス、此べるびーゆノ欄内ニハ自然通風ト強壓通風ト兩方記載シテアリマス又此比較ノ元トスル通常圓筒形汽罐ノ分ハ強壓通風ノミノ成績デアリマシテ即チ水管式ト比較シテ最モ割ノ宜シキモノヲ採テアルノデス、

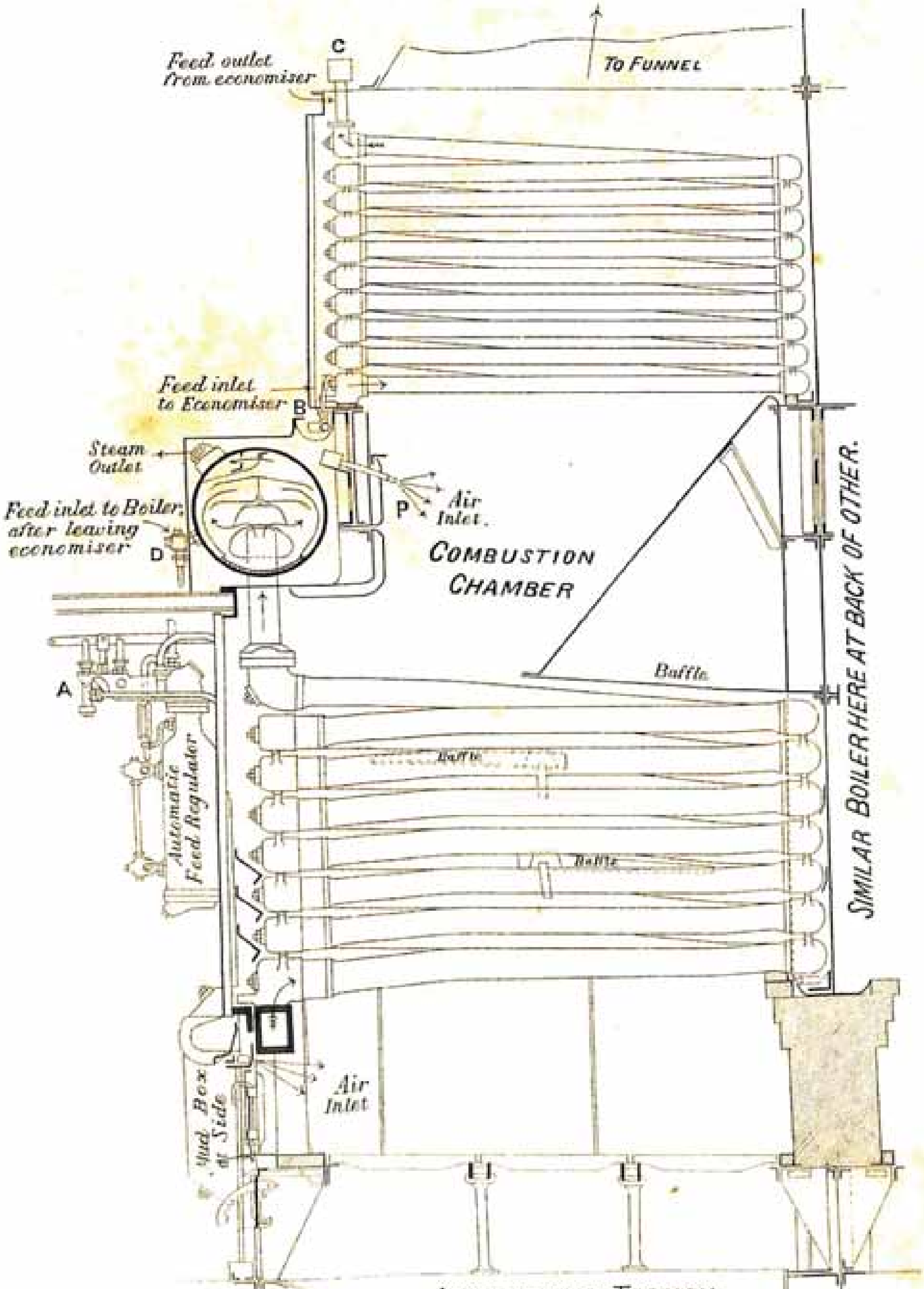
偖此表ヲ熟覽シマスルト色々ノコトガ分リマスガ先ツ重量ノ點ニ付キマシテモ罐自身ノ重量ガ輕クテモ附屬品ノ重キモノガアリマシテ一見甲乙ヲ容易ニ附ケラレマセヌ、元來一種ノ罐ガ輕イカラト云ッテモ其罐ニ關スル總體ノモノガ輕クナケレバ物ノ用ニ立チマセヌ、即チ此表デ其邊ノコトガ能ク分リマス、詰ル處此表ハ一萬馬力ニ要スル汽罐ニ計畫シテアルノデ罐自身ノ重量ハ何ウデモ宜イ即チ一萬馬力ニ對スル罐ニ關シタル直接間接ノ物、即チ悉皆罐ニ入用ナ物ニシテ船ニ備ヘル處ノ其全体ノ重量ガ多ケレバ罐ノ躰ダ丈ケガ輕クテモ何ノ役ニ立タヌ、例ヘハ先ツばぶこっくういるこっくすノ罐ニ付テ見ルト一萬馬力デ罐バカリノ重量ガ二百噸、水ノ重サガ六十六噸、火床道具、煉瓦其他色々ナ附屬品ガ七十六噸、送風機械ガ九噸、夫レカラ強壓通風用ノゑいあたいどふらっどトカ其他ノモノガ二十何噸、夫レデ罐ニ直接ニ關シタル重量ガ合シテ三百七十一噸ト云フ樣ニナッテ夫レカラ煙出シガ幾ラぽんぷヤ其他若干豫備品等ガ幾ラ、夫レカラ今度ハ六十四時間ノ間此罐ヲ使フトシテ夫レニ要スル石炭ノ重量(一萬馬力ニ對スルモノ)夫レヘ以テ二割五分多分ノ石炭ヲ加ヘタルモノガ合計七百二十噸、此七百二十噸ニ前ノ色々ノ重量ヲ加ヘテ罐ノ爲メ直接間接ニ要スル總重量ガ千百三十五噸トナリマス、軍艦デモ商船デモ之ガ大切ナル目的デアル、單ニ罐自身ガ輕クテモ此總重量ガ重ケレバ何ノ役ニモ立タヌト申スノデアル、偖此表中ノ各種ノ罐ニ付テ右ノ總重量ヲ較ヘマスルト通常圓筒形ノモノト水管式ノモノトノ差ガ餘リ大キクアリマセヌ夫レハ何故デアルカト云フト通常ノ罐ハ強壓通風ニ餘リ能ク堪ヘマセヌニモ拘ラズ強壓通風ノミヲ元トシテ算出シテアルカラシテ夫レデ斯ウナリマス、尤モ商賣船抔デハ或ル罐即チ英吉利ト愛蘭土トノ間ノ飛脚船如キモノハ常ニ強壓通風ヲ使用シテ旨ク往ッテ居リマスカラ多分夫レカラ例ヲ取ッタモノト思ハレマス、ソコデ其總重量ハ千三百十三噸デアッテそうにくろふとハ九百三十四噸はうでんハ九百七十五噸ばぶこっくういるこっくすガ自然通風デ千二百三噸強壓通風ノミナレバ千百三十五噸べるびーゆデスト自然通風ガ千二百六十噸強壓通風ナレバ九

百八十二噸デアリマス、彼樣ナ次第デアリマシテ通常ノ罐ハ强壓通風ニ能ク堪ヘルモノト見做シテモ水管式ト較ヘマスルト二百噸以上三四百噸ノ差ガアリマスカラ重量ノ點ニ付テモ何ノ道水管式ヲ採用スレバ充分利益ガアリマス、又容積ノ點ニ付テモ此表ノ末行ニ示シテアリマス如クべるびーゆ式ヲ除クノ外ハ皆一割以上ノ利益ガアリマス、處デ軍艦ハ重量ト塲所ガ大切ナ要用デアッテ經濟ノ點ハ第二ノ要點トセナケレバナラヌデスカラ罐ノ代價等ハ高クテモ夫レハ先ツ措ハヌ唯タ重量ト塲所ノ極メテ小ナルモノヲ撰ムカラ水管式ガ最モ必要ナ譯デアリマス、併シ軍艦ノ内デモ大キナ甲鐵艦トカ巡洋艦トカ云フモノハ經濟ノ點モ大ヒニ考ヘナケレバ餘程國庫ノ經費ガ違ヒマスカラ重量、容積、製造、維持費等ノ要點ヲ俱ニ見ナケレバナリマセヌ、軍艦ノ中デモ代價ノコトヲ構ッテ居ラレヌノハ水雷艇トカ驅逐艇トカ云フモノデシテ大キイ軍艦ニナルト重量位ハ小々大ナルモ代價ノ安イ方ガ宜シイト云フコトニモナル、夫レカラ商賣船ハ其種類ヲ大別シマスレバ三通リアルノデ第一ガ飛脚船第二ハ荷物ト客ト兩方ヲ載セルモノ第三ハ本當ノ荷物船デアル、サウシテ郵便飛脚船ニハ殊ニ水管式ガ適當スルノデアル、ト云フノハ重量モ輕イシ容積モ小サイ、夫レカラ客ト荷物ト混ッタモノニハ第一種ノ如クニ大ナル利益ハ無イトシテモ夫レ相應ニ容易ナラザル利益ガアリマス、荷物船ニハ大シタ利益ハ無イガ之モ幾分カ利益カアルニ違ヒハナイ、

夫レデ何ッカ此會員諸君ハ船舶ニ關シテ居ラル、諸君デスカラ一日モ早ク水管式汽罐ヲ採用スルコトニ御注意ナリタイ、夫レニハ今マデ幾個モ歐羅巴デ有名ナ水管罐ガ澤山出來テ居リマスカラ早ク御採用ニナル樣ニ御盡力ニナッタラ國家ノ爲メニナルコト、思ヒマスカラ聊カ愚見ヲ申シ陳ヘ置ク次第デゴザイマス、

第壹號圖

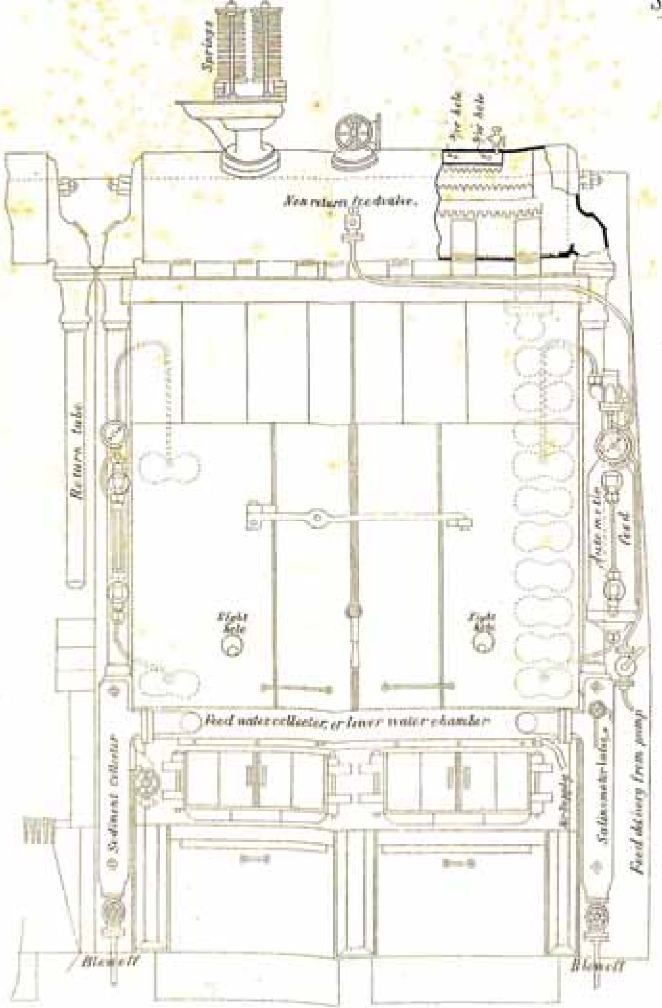
BELLEVILLE BOILER.

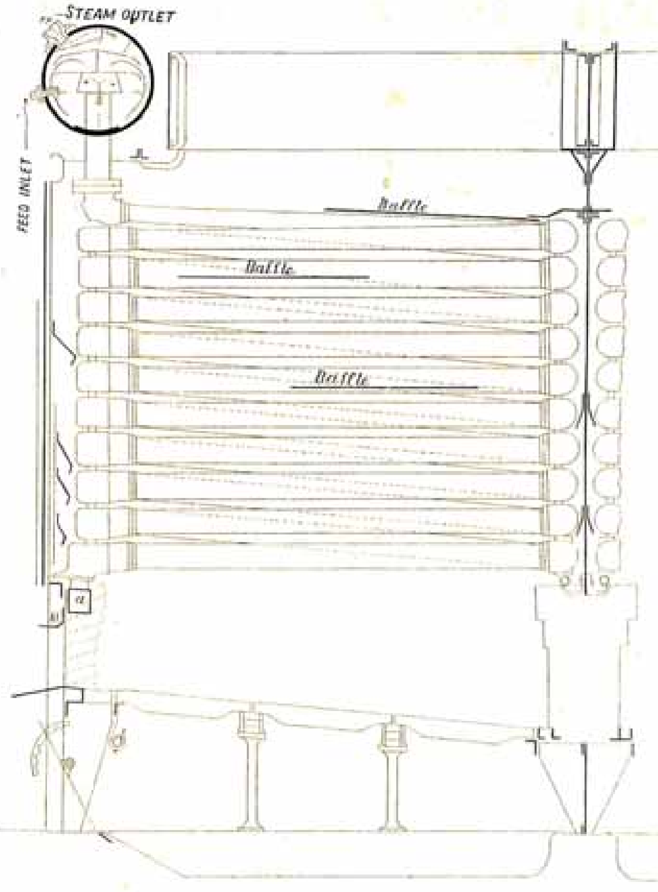


第壹號ノ一

Belleville Boiler.

Scale ½ inch – 1 foot.



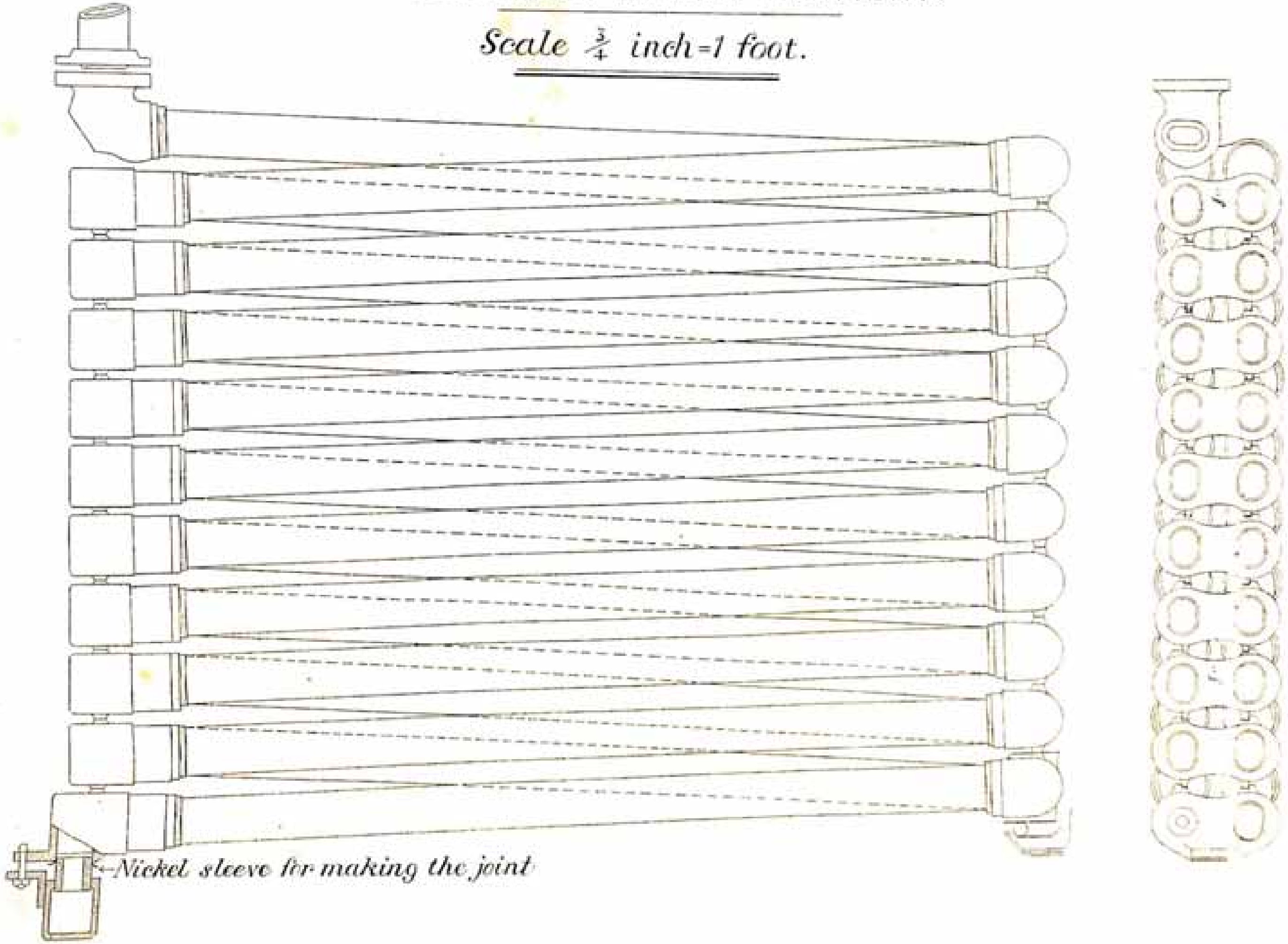


(a) Feed water collector.
(b) Air distributing chamber.

第壹號ノ一附圖

BELLEVILLE BOILER ELEMENT.

Scale $\frac{3}{4}$ inch=1 foot.

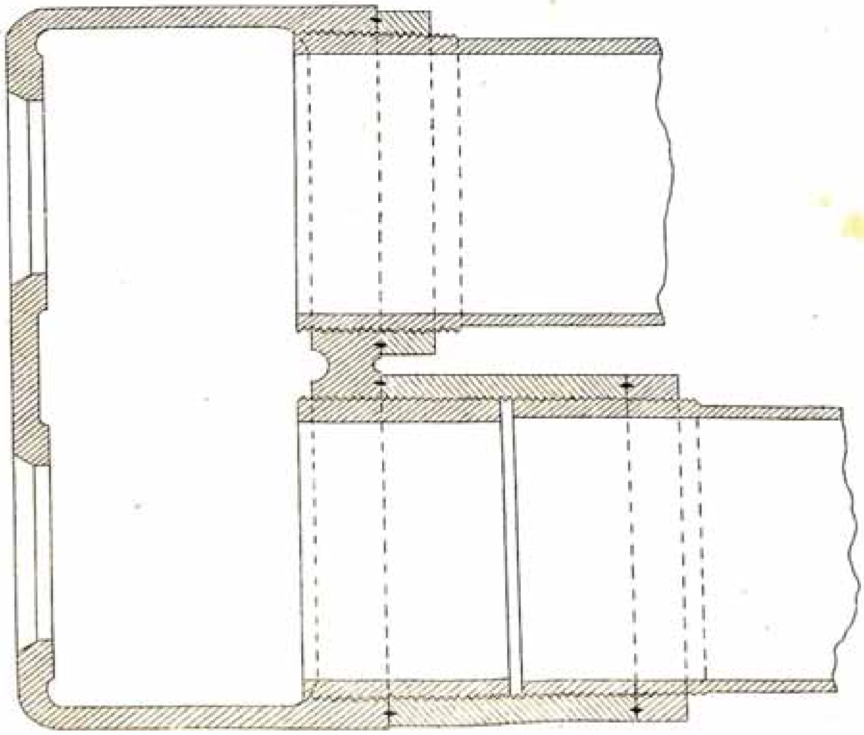


第壹號ノ二

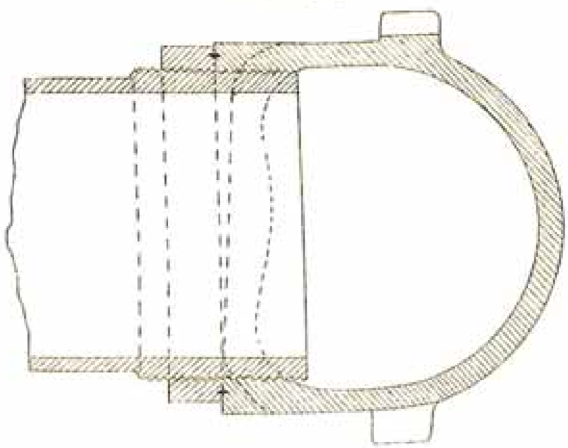
BELLEVILLE BOILER TUBE CONNECTIONS

Scale. 4 ins = 1 foot.

Front box.



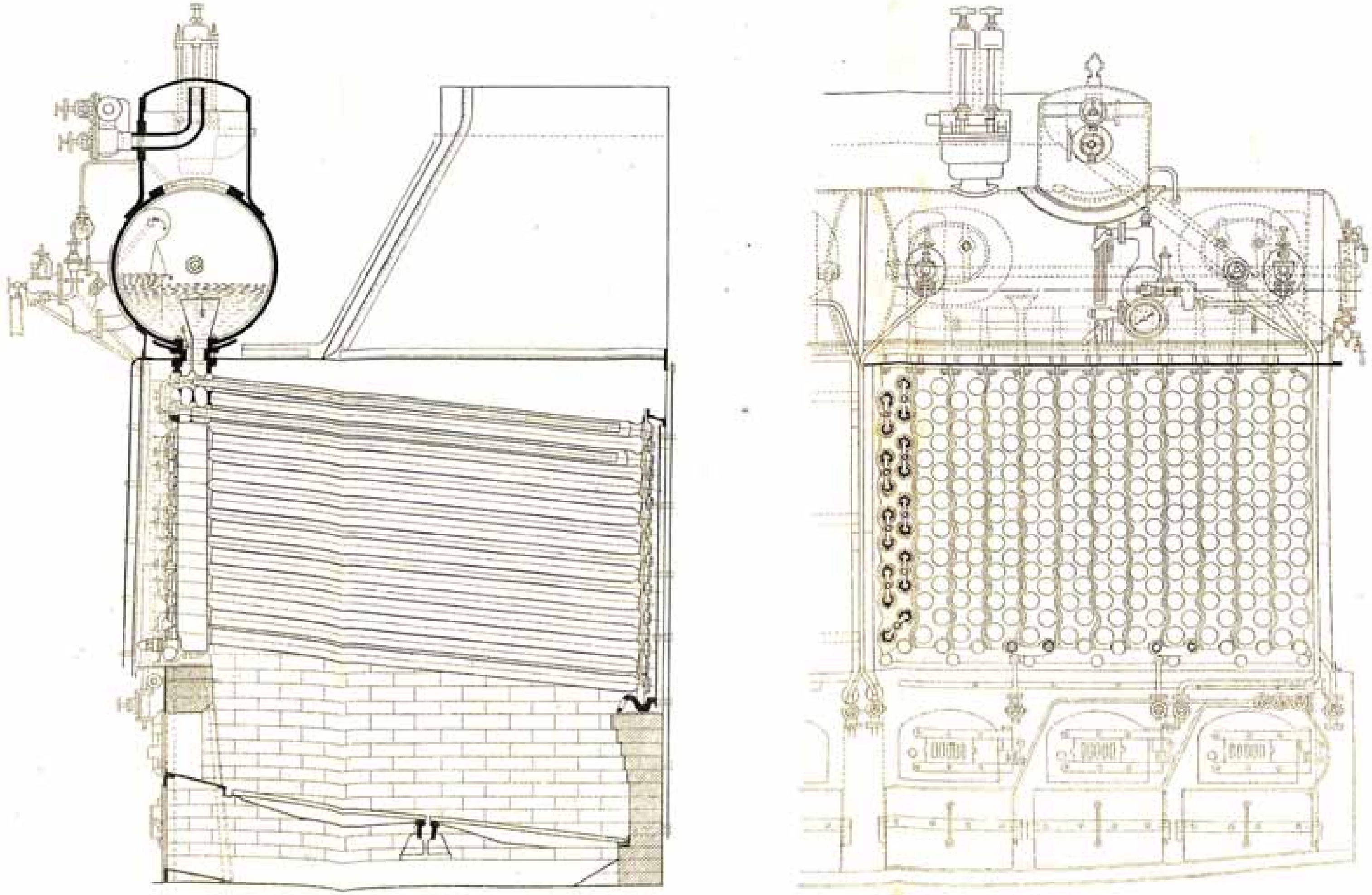
Back box



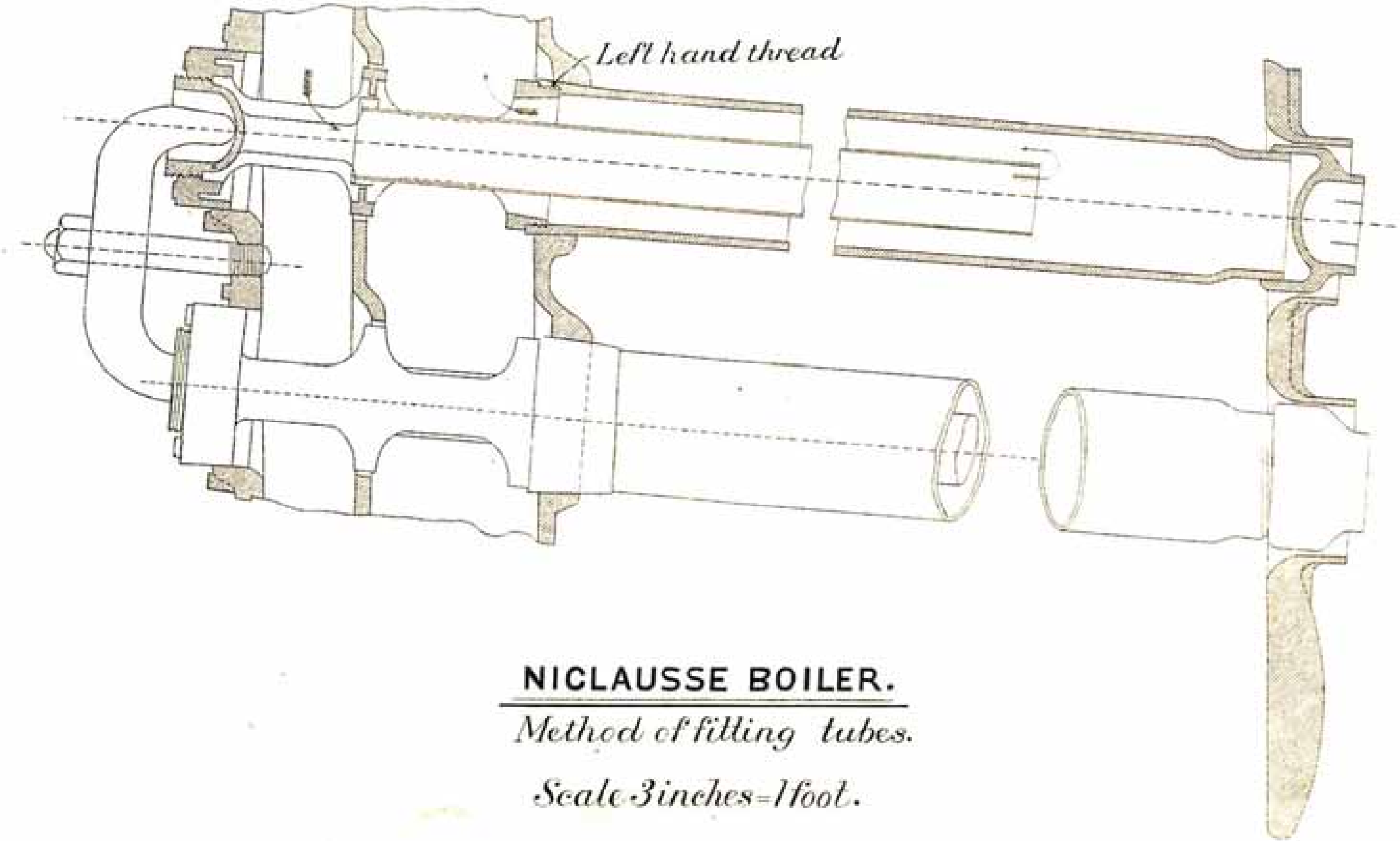
第二號圖

NICLAUSSE BOILER.

Scale ½ in = 1 foot.



第二號ノ一



NICLAUSSE BOILER.

Method of fitting tubes.

Scale 3 inches = 1 foot.

第三號圖

BABCOCK & WILCOX WATER-TUBE BOILERS.

Fig. 1.

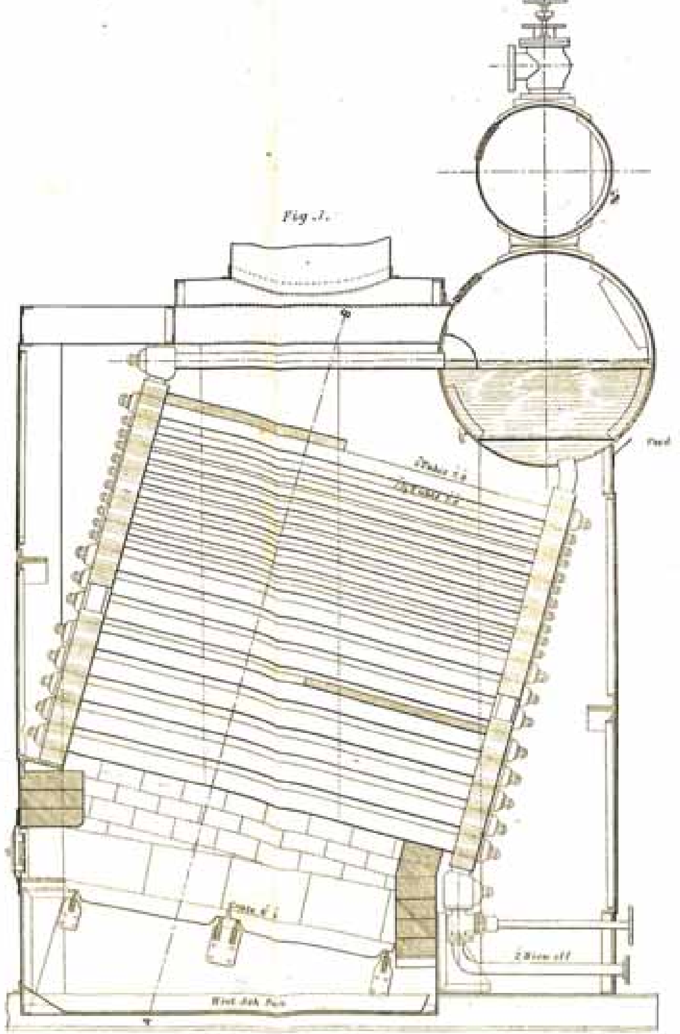
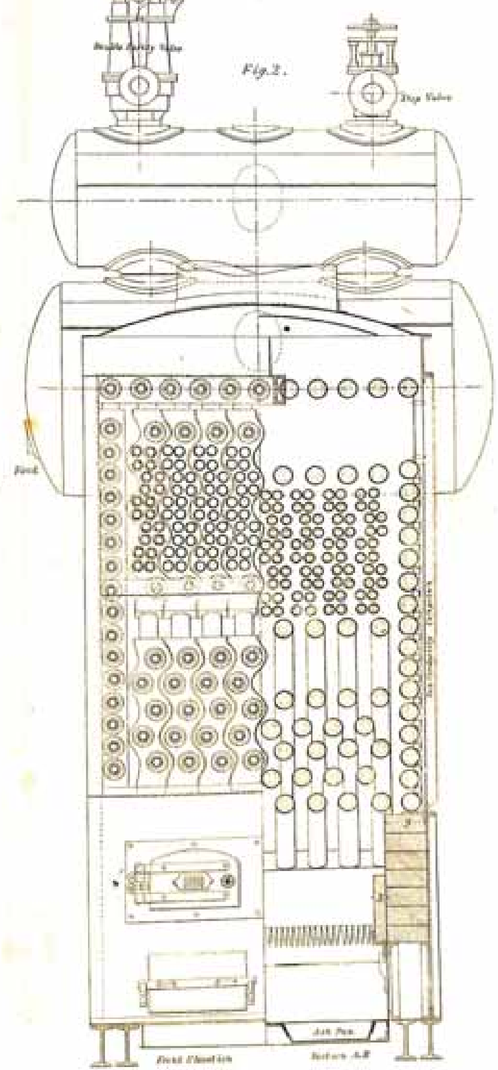


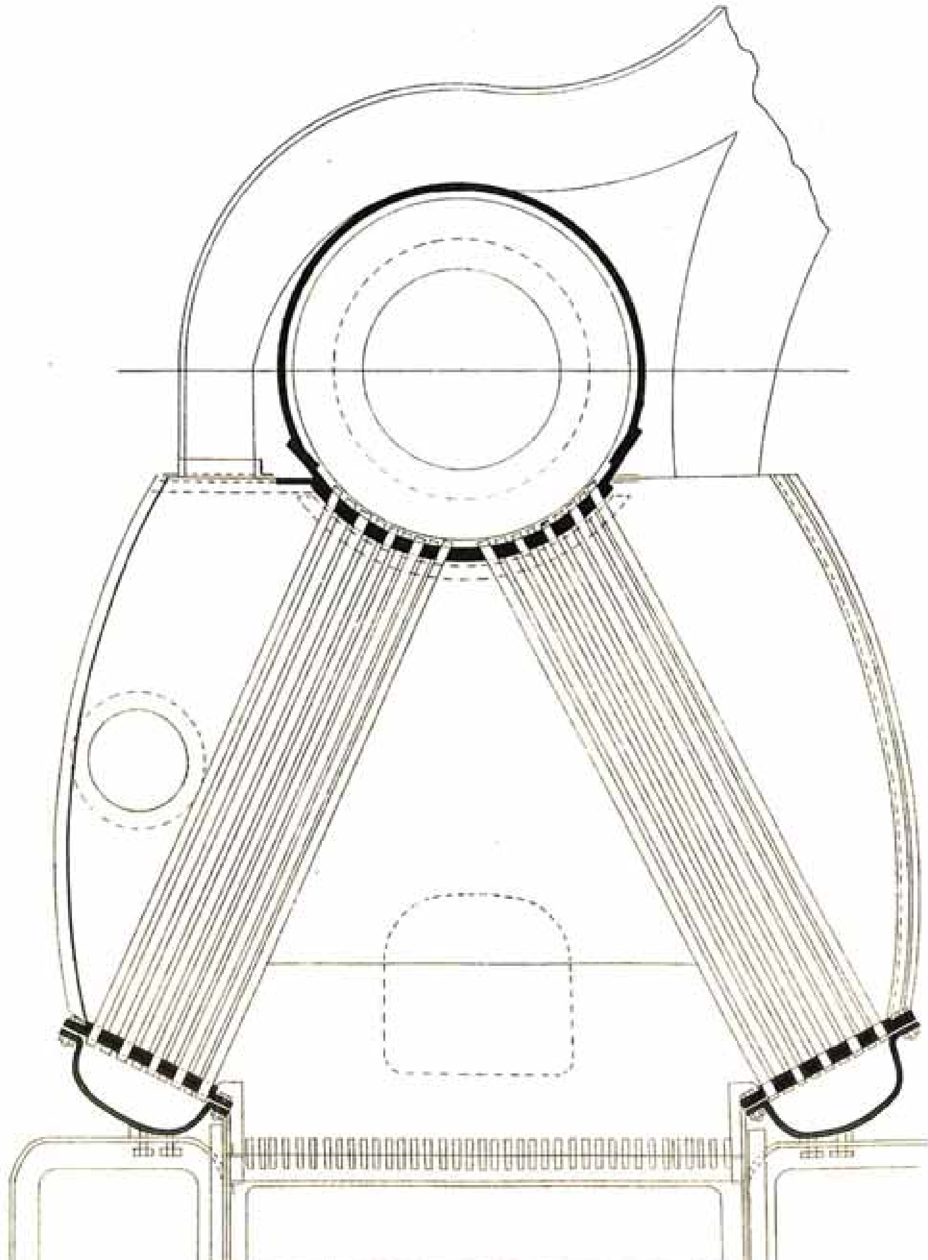
Fig. 2.



第四號圖

YARROW BOILER

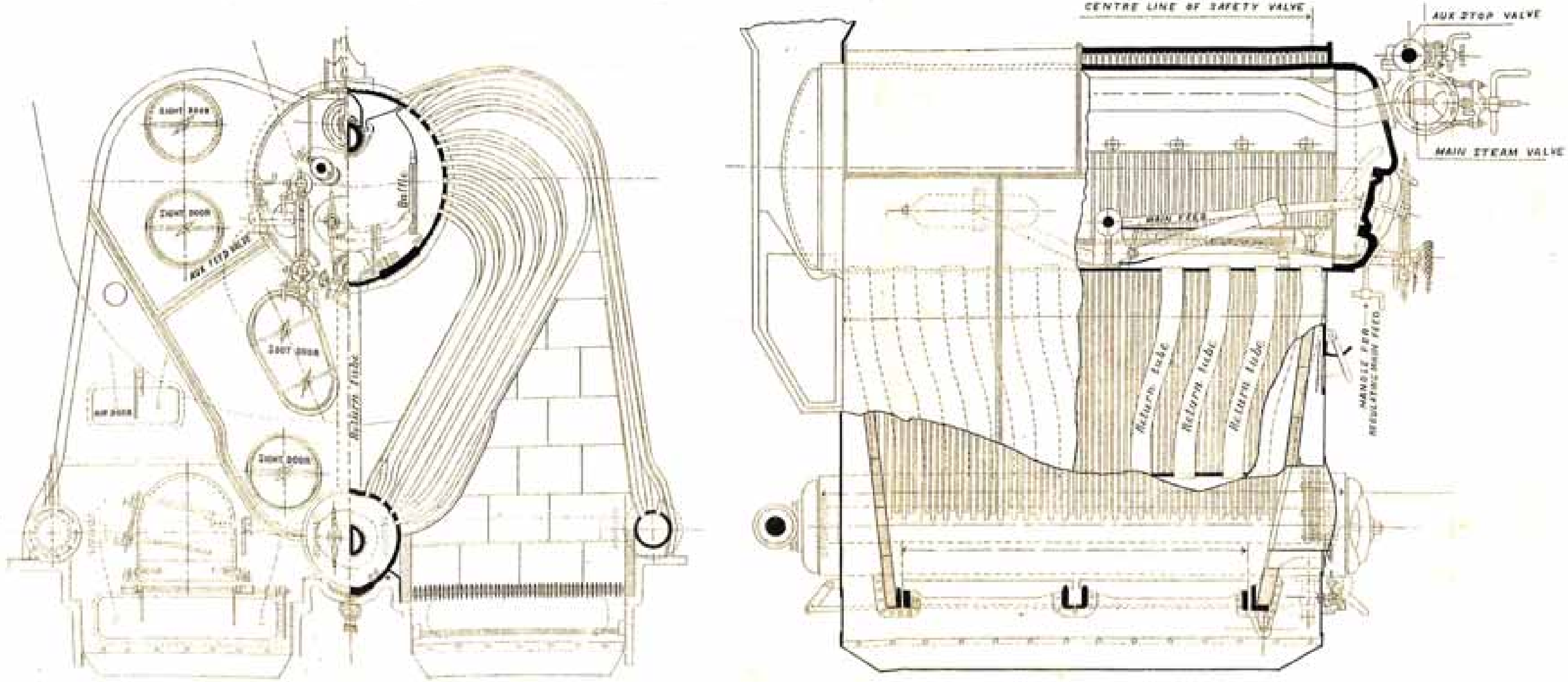
Scale $\frac{3}{4}$ in = 1 foot.



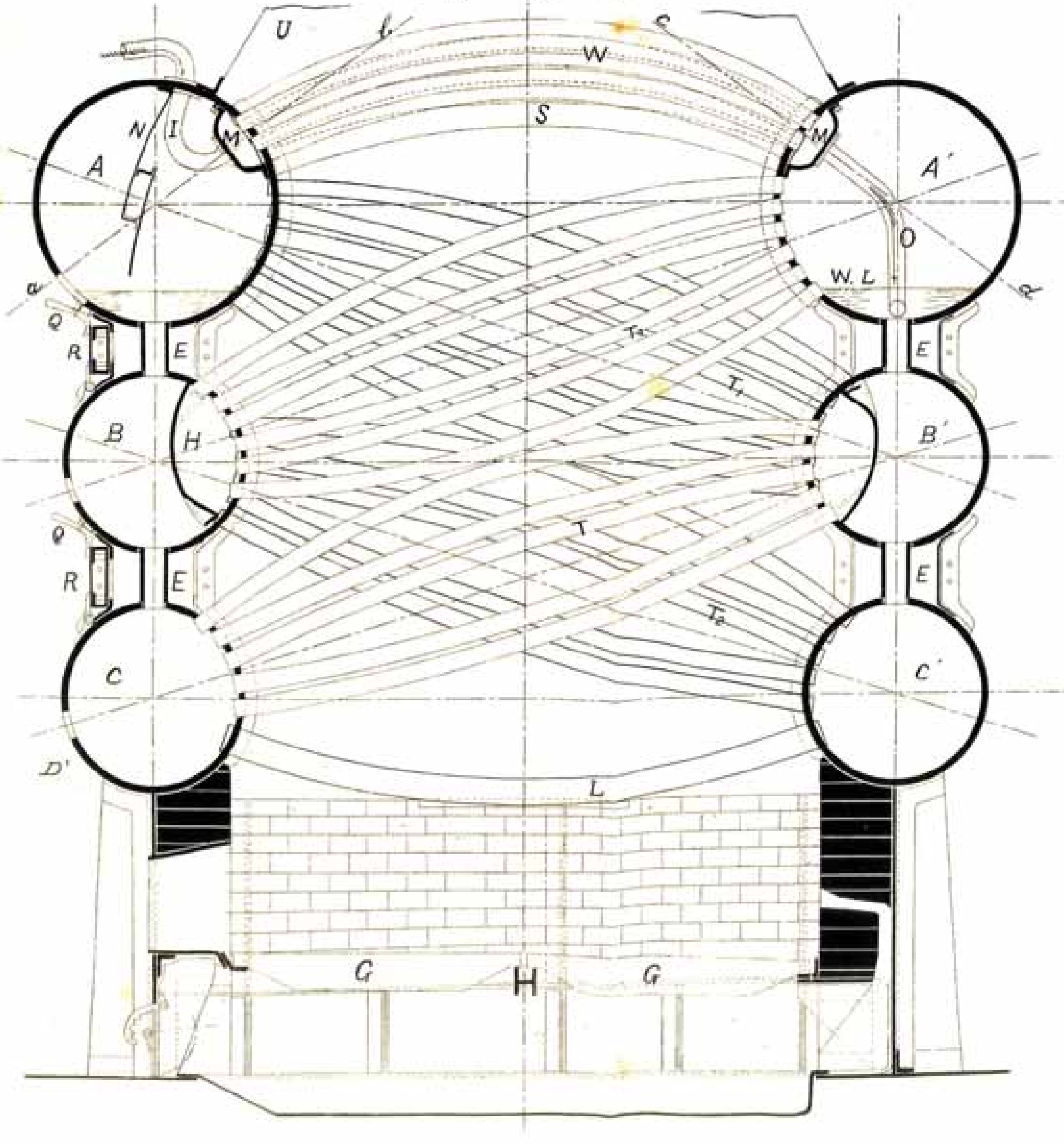
第五號圖

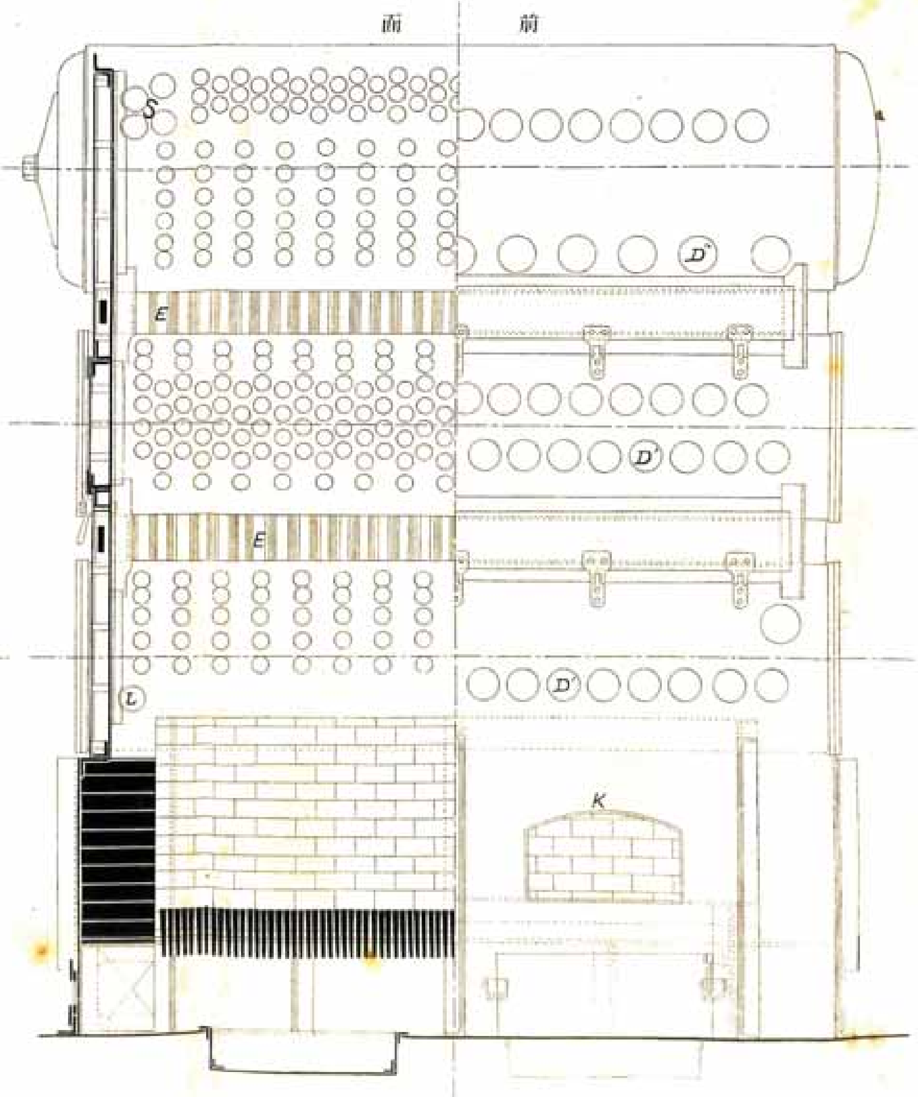
THORNYCROFT BOILER "DARING" TYPE.

Scale ½ inch = 1 foot.

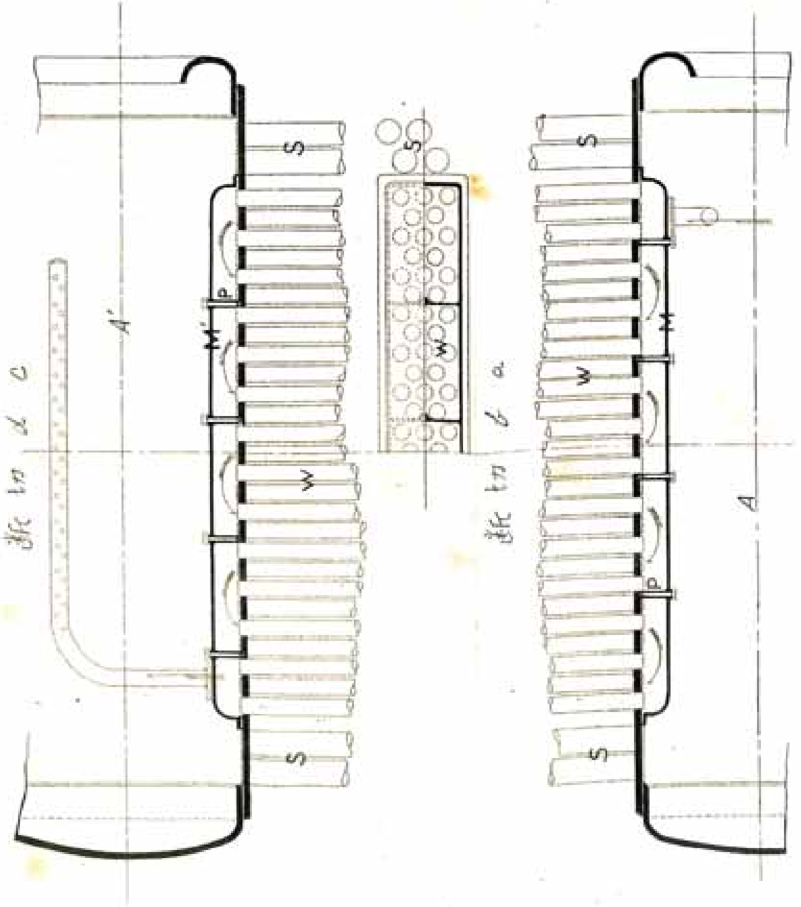


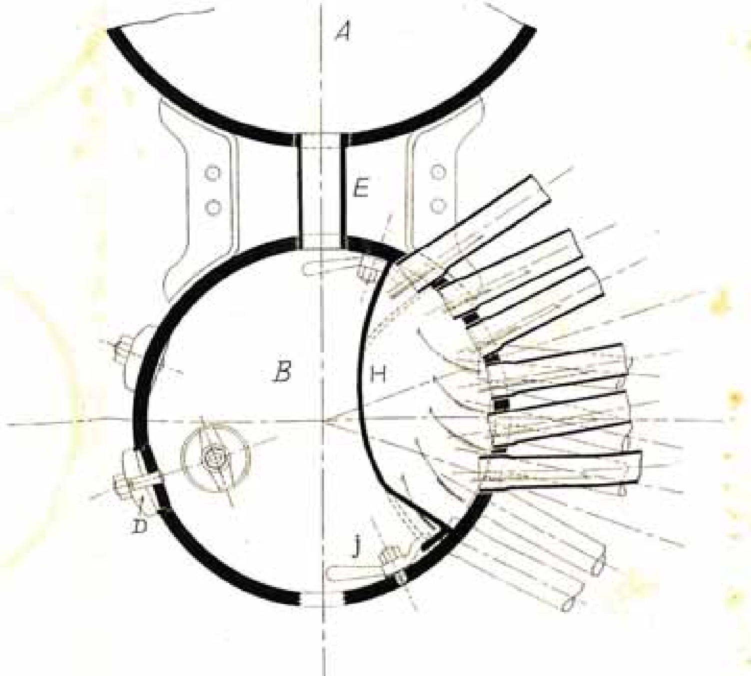
第六號圖
宮原式水管滊鑵

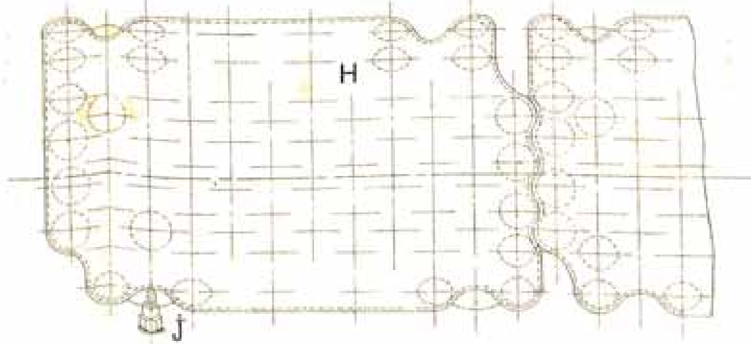




第六号 圖付屬







一

第一表

水管式汽罐

蒸發功力試驗成績對照表

	試驗時間	壓力壹平方吋	火床面壹平方呎每一時間石炭燃燒高	給水溫度	Water per lbs of cool	Water from & at 212°	Air pressure
宮原式	4	180	14	59°	9.247	11.18	
	4	180.25	20	83.5°	9.894	11.73	
	4	179.5	20	83.375°	10.01	11.87	
	4	181.0	30	76.0	8.86	10.58	$\frac{1}{2}$ to $\frac{3}{4}$″
	4	180	30	83.4	8.35	9.85	〃
	4	180	40		7.81	9.194	1″
	4	181	40		8.99	8.8	1″
ベルビーユ	5	260	18			10.81	
	5	260	24			10.42	
	4	220	28.6	50	8.00	9.95	
	4	250	30			9.2	
エコノマイザー付	·4	240	18.26	60	9.936	12.16	
	4	240	30.6	60	9.327	11.41	
ニクロース	8	166	19.	71.3	9.25	11.07	
	8	173.5	29.9	66.9	8.34	10.2	
	8	171.5	35	58.2	7.93	9.6	
ソーニクロフト	4	187	25.4		8.14	10.04	
	5	187	31.0		7.98	9.82	
	4	192	43.6		7.45	9.15	

試驗ニ使用シタル石炭　上等英炭

壹萬馬力各種汽罐對照表

但シ各自同一汽船ニ使用ノモノト假定シテ算出セシモノナリ

ON BOILER INSTALLATION FOR STEAMER.

第二表

I.H.P. 10000

	Closed Stokehold	Martion Indneed	Belleville		Babcock Wilcox		Howden	Thorny Croft	宮原		
			Forced	Natural	F	N	F	F	F	N	
No. & Description of Boiler	4 Double ended Cylindrical	4 Double ended Cylindrical	12 11 Element	18 ditto	10	12	4 Double ended Cylindrical	8 Single ended	10 Single ended	12 ditto	1
Sizes	15′−2″ ×19′−6″	15′−2″ ×19′−6″	″Generatry 2¾Econoer	,, ,,	—	—			2″ Tubes	ditto	2
Working Pressre	200	200	260	260	200	200	200	210	200	200	3
T. Heating Surfce	20000	20000	21000	31500	27000	32400	15400	28000	23560	30400	4
Grate Surfce	536	536	633	950	615	738	436	480	620	800	5
Air pressure	1″−1½″	1″−1½″	¾″	—	1″−1½″	—	1″−1½″	1″−1¼″	¾″−1¼″	—	6
Wt of boilers uptakes laggings	355	359	150	206	200	246	267	105	183	236	7
Wt of hot water	159	159	22	32	66	79	132	16.75	53	68	8
Wt of fire, steam & water mountings	35	35	81	120	76	92	36	32	60	76	9
Wt of fans blowers heater tubes.	9	9	23.5	43.75	9	4	7.25	4	9	4	10
Wt of Air tight flats & seatings	12	7	13 5	20.25	20 25	18	13,75	12	15	12	11
Total weight	570	569	290.5	42225	371.25	439	456	168	320	396	12
I. H. P. per ton	17,54	17.57	34.4	23.69	26.94	22.82	21.94	59.6	31.25	26 35	13
Wt of funnels	18	17	17	25.5	20	21	20	15¾	20	21	14
Wt of feed pumps and copper pipes	11.5	11.5	14	15	11.5	11.5	11.5	11.5	11.5	11.5	15
Spare gear	5	5	10	15	5	5	5	5	5	5	16
Wt of Stoke hold floor	7.5	7.5	7.5	11.5	5.25	6.25	7.5	5.75	5	6	17
Separator Redne Valves	—	—	7	10	—	—	—	1.75	—	—	18
Wt of coal carried for 64 hours + 25 %	700	700	750	625	720	720	475	725	665	600	19
T. W. of Installation	1313¼	1311	1130	1150	11.35	1203	975.75	934.5	1070	1040	20
I. H. P. per ton	7.61	7.62	10.18	7.99	8.81	8.31	10.24	10.73	9.32	9.6	21
I. H P. per sq. ft. grate	18.65	18.65	15.8	10.52	16.26	13.5	22.91	20.62	16.1	12	22
Lbs of coal per I.H.P.	1.96	1.96	2.1	1.75	2.01	2.01	1.33	2.06	1.86	1.65	23
Length of Boiler space over bunkers	124′−0″	124′−0″	125′−0″	145′−0″	99′−6″	105′−0″	97′−0″	104′−0″	115′−0″	118′−″	24

All weight Tons.

AN IMPROVEMENT TO AMSLER'S PLANIMETER.

By

Prof. Hillhouse., B. Sc.

My Lord President and Gentlemen,

It is a well known saying that a bad workman always quarrels with his tools but this is probably only another way of stating the fact that a good workman always takes care to obtain the very best tools and also to keep them always in perfect order and that he is always ready and willing to welcome any improvement to those already found satisfactory.

One of the most useful instruments at the the disposal of the Naval Architect and the Marine Engineer is Amsler's Planimeter, or Area Measurer, which as you all know is a small machine designed so as to give accurately the area of any figure whatever drawn upon paper, by the simple process of tracing its periphery, reading the indication of a graduated wheel and applying one or more numerical factors. In most cases there will be at least two factors, one depending upon the 'setting' of the instrument or the length of its sliding bar and the other upon the circumstances of the problem and on the particular units in which the result is desired.

My proposed improvement consists in enabling the instrument to be so 'set' to suit early particular case that these final factors are very greatly simplified or else omitted altogether. To do this it is necessary to make a preliminary calculation of the proper length to be given to the sliding bar and at first sight it appears as though my idea was similar to that of the celebrated Irishman who cut eighteen inches off the bottom of his blanket in order that he might sew it on to the top! But there is some difference between the two cases. For although it is true that I propose to save a final calculation by making a preliminary one, yet once that preliminary calculation has been made and the proper 'setting' noted it will never require to be made again but the same setting will be used whenever similar requirements recur. Thus one preliminary calculation saves daily final calculations and a saving of time is effected. I propose to tabulate these settings and supply them along with the instrument so that the operator will have hardly any arithmetical work to perform.

The upper figure of Plate III. shows the Planimeter as usually supplied with two fixed points or settings, marked 10 □" and 20 □" respectively because one complete revolution of the wheel indicates those areas when the instrument is set at the two points.

The lower figure shows the instrument improved as I suggest by the very simple process of engraving upon the sliding bar a continuous decimally divided scale marked from 10 to 40 so that the setting gives the corresponding length of the sliding bar in quarters of an inch. I have here also actual planimeter arranged as described.

To either instrument will be fitted if so desired, two inverted points shown in black for use on indicator diagrams as will be explained presently.

In order to make the use of this scale intelligible I hope you will pardon me if I go through some very elementary geometry and explain the principles upon which the plamineter is based.

Let us first consider the area generated by the movement of any straight line confined to a plane. If the line PH move from the position marked PH to that marked P_1H_1, its extremities moving along the curved paths PP_1 and HH_1 and its successive positions being shown in blue, the whole area generated is that swept over by the line and is therefore PP_1H_1H or the area lined in blue, and we will agree to look upon this as a positive area.

Next suppose that the line PH, instead of moving to the left, moves towards the right from PH to P_1H_1. The area generated is that lined in red, but as this area was swept over in the opposite direction to that first considered it must be treated as a negative area.

We therefore agree to the following rule:—All areas swept over by the line PH shall be reckoned + when the left hand side goes first and − when the right hand side goes first.

Now suppose that PH moves first towards the left and arrives at P_1H_1 and there returns along the same lines to some intermediate point $P_{11}H_{11}$. The whole area generated is only that between the first and final positions, as the part $P_{11}H_1$ has been swept over once positively and once negatively and the second operation has cancelled the first.

In the next place let us suppose that each end of PH describes some closed curve in the directions shown by arrows so that the line comes back to its starting point. What is the total area generated? The part lined in blue (B) was described by a motion towards the left and is therefore +, the part lined in red (C) was described by a right hand motion and is therefore negative, while the two parts lined both blue and red have both been passed over twice, once positively and once negatively and therefore cancel out altogether. The total area swept over is therefore $+B-C$. Now let us add and subtract the small area A lying between the curves and untouched by the moving line. We thus get Whole Area developed $= +B+A-C-A$

$$=(B+A)-(C+A)$$

$$=\text{Area traced by P} - \text{Area traced by H.}$$

Hence we have the following simple rule:—If any straight line moves in any way whatever and returns to its original position the whole area generated by that line is equal to the difference between the areas of the closed curves described by its extremities.

If we confine one end of the moving line, say H to any straight or curved line in such a way that it can only move backwards and forwards along that line, then the area described by it will be zero and the whole area generated by the moving line will be equal to that described by the other extremity. This is shown in the last figure and is the principle involved in Amsler's Planimeter where the moving line is the portion of the sliding bar between the pointer P and the hinge H. The pointer P is made to pass once completely round the area to be measured while the hinge H is compelled to move in a circle by means of the radial arm CH.

We now know that when the pointer P has been taken round the periphery of any figure the area of that figure must be given by the area swept over by the part of the sliding bar between the pointer and the hinge and we must now seek for some means of measuring this latter area.

Turning our attention to plate II. let us suppose that PH and $P_{11}H_{11}$ are two successive positions of the sliding bar exceedingly close together. The area generated is that coloured blue. If we produce the initial and final directions of PH until they meet at 0 we see that the same result would have been obtained if the line PH had revolved about 0 as a centre into the position P_1H_1 and had then slid along itself to the position $P_{11}H_{11}$. The area generated may therefore be taken as PP_1H_1H.

$$\text{But area } PP_1H_1H = PP_1O - HH_1O = \tfrac{1}{2}p^2d\theta - \tfrac{1}{2}h^2d\theta$$
$$= \tfrac{1}{2}d\theta(p+h)(p-h)$$
$$= m.L.d\theta = L.m.d\theta = L \times MM_1$$

= length of line × distance travelled by its middle point M in a direction $\perp^r$ to the line.

Extending this result to the case of any large area regarded as being made up of an infinite number of small elements similar to PH_{11}, we see that the area generated by the motion of any straight line is equal to the product of the length of the line and the distance travelled by its centre of gravity in a direction perpendicular to itself.

If now we attach a small wheel to the middle point of our moving line, with its axis in the line and allow it to roll over the surface of the plane in which the line moves, its circumferential travel will give us the second factor of the above product. By graduating the circumference of the wheel and arranging suitable indexes and counting mechanism we can obtain a record of the distance travelled by the middle point of the sliding bar in a direction perpendicular to itself.

Of course any motion of the middle point in a *direction parallel* to the line will not affect the wheel, which would merely slide over the surface of the paper without rolling.

But if, in place of fixing the rolling wheel at the middle point M of PH, we were to fix it at some other point W at a distance as w from the middle point, what will be the result? In the actual Planimeter the wheel is not at the middle of the sliding bar and it is rather a curious thing that the actual position of the wheel makes no difference whatever to the resultant reading as long as its axis remains parallel to the sliding bar and the pointer P returns to its initial position.

To understand this look at the enlargement of the portion WM of the sliding bar. When the wheel is fixed at W its reading gives us the distance WW_1. But $WW_1 = Mm + mW_1 = MM_1 + mW_1$, M_1m being drawn parallel to MW and the angle W_1M_1m being therefore equal to $d\theta$.

$$mW_1 = w.d\theta \qquad \therefore \quad MM_1 = WW_1 - wd\theta$$

Now the whole area generated when the pointer has returned to its starting point is

$$L \times \Sigma MM_1 = L\Sigma WW_1 - L\Sigma wd\theta$$
$$= L + \text{Reading of wheel} - wL\Sigma d\theta$$

but as the line PH is finally in the same direction as it was initially $\Sigma d\theta = 0$

$$\therefore \quad \text{Area generated} = L \times \text{Reading of wheel.}$$
$$\text{or} \quad A = L.R.$$

We have thus obtained the rule upon which the use of the planimeter is based, namely that the area of the figure circumscribed by the pointer is obtained by multiplying the 'reading' of the wheel by the 'setting' of the instrument or by the length of the sliding bar.

If the reading and setting are both expressed in inches the area will of course be obtained in square inches and so on. The circumference of the rolling wheel and the length of the sliding bar are usually divided in quarter inches and decimals thereof so that the area comes out in square quarter-inches. As there are 16 of these units in a square inch the true area in □" is $\frac{1}{16}$th of the product R.L

$$\text{or Area in } \square'' = \frac{RL}{16}$$

Now it usually happens that it is required to obtain an area in units other than square inches and from a drawing on some scale other than full size. Let us suppose that there are n of the proposed linear units in one inch or in other words that the area is required in square n^{ths} of an inch. There will be n^2 of these units in a square inch and consequently the actual area of the figure operated upon will be

$$\text{Actual area in } \square\ n^{ths} \text{ of } 1'' = \frac{RL}{16} \times n^2$$

But as the drawing is not a full sized one this actual area represents some larger or smaller area.

Let us suppose that the drawing is on a scale of $\frac{1}{m}$th of the linear dimensions of the thing represented.

Then the area represented by any part of the drawing will be m^2 times the actual area of that part.

$$\therefore \text{ Area required} = \text{Actual Area} \times m^2$$

parallel in required units $= \frac{RL}{16} n^2 m^2$

For example take the very ordinary case where the drawing is on a scale of $\frac{1}{4}'' = 1'$ and the area is required in square feet.

Here $m = 48$ and $n = \frac{1}{12}$

$$\therefore \text{ Area} = \frac{R.L}{16} 48^2 \frac{1}{12^2} = R.L.$$

In the old form of instrument L can only be made = 16 or 32 and these become the 'multipliers' which must be used.

If a continuous scale of L is engraved upon the sliding bar L may be made 20 or 40 much more convenient numbers or if the instrument is set at 33.33 or $\frac{100}{3}$ it will only be necessary to divide the wheel reading by 3 and shift the decimal point.

Again if the scale of the drawing be $\frac{3}{8}'' = 1'$ or $\frac{1}{32}$ of full size and the area is required in square feet we have

$$A = \frac{RL}{16} 32^2 . \frac{1}{12^2} = \frac{4}{9} RL.$$

If L must be 16 or 32 our multipliers can only be $\frac{64}{9}$ or $\frac{128}{9}$ both awkward numbers.

By means of the scale however we may make $L = 22.5 = \frac{90}{4}$ when $A = \frac{4}{8} R \frac{90}{4} = 10$ R. and it is only necessary to attend to the proper placing of the decimal point.

We might have a drawing on a French metrical scale of $\frac{1}{50}$ and be asked to find the number of square feet represented by any part of it.

Here the two instruments would compare as follows:—

Area$=\frac{RL}{16}50^2\frac{1}{12^2}$: Set to point marked 10□", L=16 and multiply reading by $\frac{2500}{144}$.

With scale, set to 27.648 and multiply reading by 30.

If we have a map on a scale of 6" to 1 mile and require any area in Tsubos we must set the older instrument to 20 □" say, and multiply the reading by $\frac{387200}{9}$ while if we can make L=37.19 our multiplier reduces to $\frac{100000}{2}$.

And so on, many other examples might be given showing how we may in every case so arrange our setting that the multiplier required to give an area in any required units may be a very simple and easily applied number.

Another use to which the scale may be put is to enable the instrument to give directly the weight per foot run of any given sections of any material, from a scaled drawing of that section. For example suppose we have a full sized drawing of the section of a steel deck beam and want to know its weight in lbs per foot.

Here we have Area of Section in □'$=\frac{RL}{16}\frac{1}{12^2}$

= Volume per foot run in cubic feet.

Hence Weight per foot run$=\frac{RL}{16}\frac{1}{12^2}490$ lbs.

$$=\frac{RL}{4{\cdot}702}$$

Making $L=5\times4{\cdot}702=23{\cdot}51$

We have $w=R\times5=\frac{10R}{2}$

Or again we may obtain very easily the number of lineal feet of material of any given breadth required to cover a given surface.

Suppose a ships deck has to be covered with planking $4\frac{1}{2}$" wide and that we have a drawing of the deck plan on a scale of $\frac{1}{16}$"=1' $\left(\frac{1}{192}\right)$

Here area in □'$=\frac{RL}{16}192^2\frac{1}{12^2}$ and area in units of $12"\times4\frac{1}{2}"$ or number of lineal feet of $4\frac{1}{2}$" planking required

$$=\frac{RL}{16}192^2\frac{1}{12^2}\frac{12}{4{\cdot}5}=\frac{RL}{{\cdot}02344}$$

Setting L to 23·44 we get

Length of Planking$=1000\times R$

In such cases only the net length is obtained and a suitable allowance would have to be made for cuttings and waste.

In short the adoption of the continuous decimal scale in place of the two fixed points enables us to simplify the arithmetical part of the work and to obtain directly from the wheel-reading any quantity which is only dependent upon that area such as lengths weights and costs of materials and even the number and weight and cost of fastenings.

A small book of tables would accompany each instrument giving the proper settings and multipliers for all cases likely to arise in practice and a few blank pages would be left on which any engineer, architect, surveyor or shipbuilder could enter any other multipliers which he found useful in his own particular profession.

These settings would be systematically arranged and would only require to be calculated once and would then do fos all subsequent calculations.

Plate 4 is a sample table.

The scale might also be very usefully employed in a class of calculations very common in shipyard drawing offices namely the roughing out of the displacement when preparing a new set of lines.

In this process we obtain a 'Planimeter Reading' for each of the equidistant cross sections of the vessel, multiply each by its appropriate 'Simpsons multiplier' and add the products together obtaining a sum which we may call d. If h be the horizontal interval between the sections and $\frac{1}{m}$th their scale we have Displacement in Tons

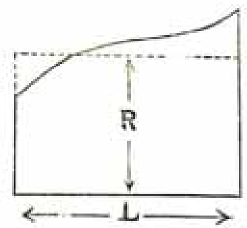
$$=d \times \frac{L}{16} \times m^2 \times \frac{1}{12^2} \times \frac{2}{3}h \div 35$$

$$=d. \quad \frac{Lm^2h}{120.6}$$

By suitably arranging L with reference to m and h we may make the latter factor a very simple one and if the displacement has to be run out often during the process of fairing a considerable saving of time will result.

Finally as to the use of the two inverted points. These are so arranged that their distance apart is always equal to the distance from pointer to hinge, that is to the length L of the sliding bar, and to the "setting" of the instrument.

Suppose now that we have any curved area of any length L and that we turn our planimeter upside down and set the two inverted points to the extremities of the base line of our curve. Then the "length" of the planimeter is equal to the length of the curve.



$\therefore$ Area of Curve = Reading × Length.

$$\therefore \quad \text{Reading} = \frac{\text{Area of Curve}}{\text{Length of Curve}} = \text{Mean Ordinate.}$$

This result shows the advantage and proves the accuracy of the planimeter with inverted points for indicator diagram work where only the mean ordinate and not the area is required.

If might also be frequently useful in other cases and its adoption is not so general as I think it should be.

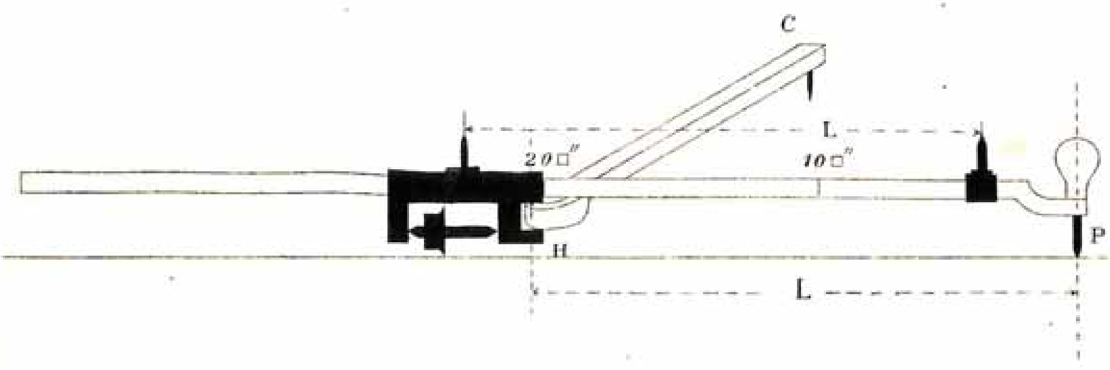
As the distance between the inverted bayonet points is exactly the same as the length L between pivot and hinge all the advantages of an instrument having a continuous engraved decimal scale may be obtained from an instrument not so provided by the application of a separate ordinary decimal drawing scale of quarter inches to measure and fix the distance between the two inverted points.

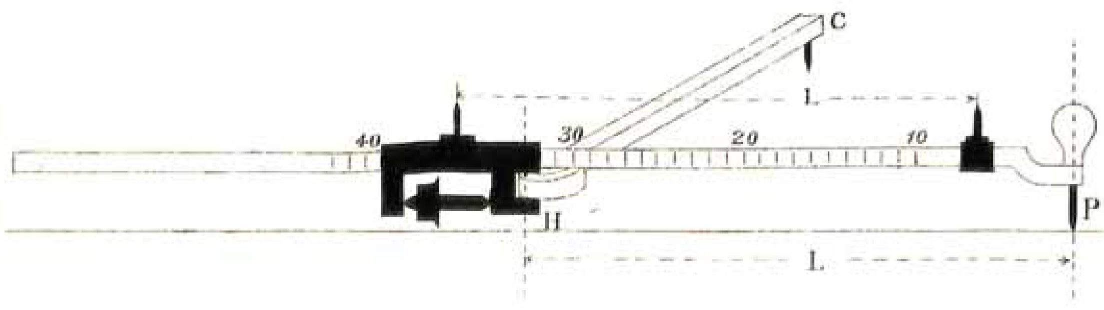
The adoption of an engraved scale makes the instrument self contained and obviates any inaccuracies which might arise from the use of various slightly differing scales.

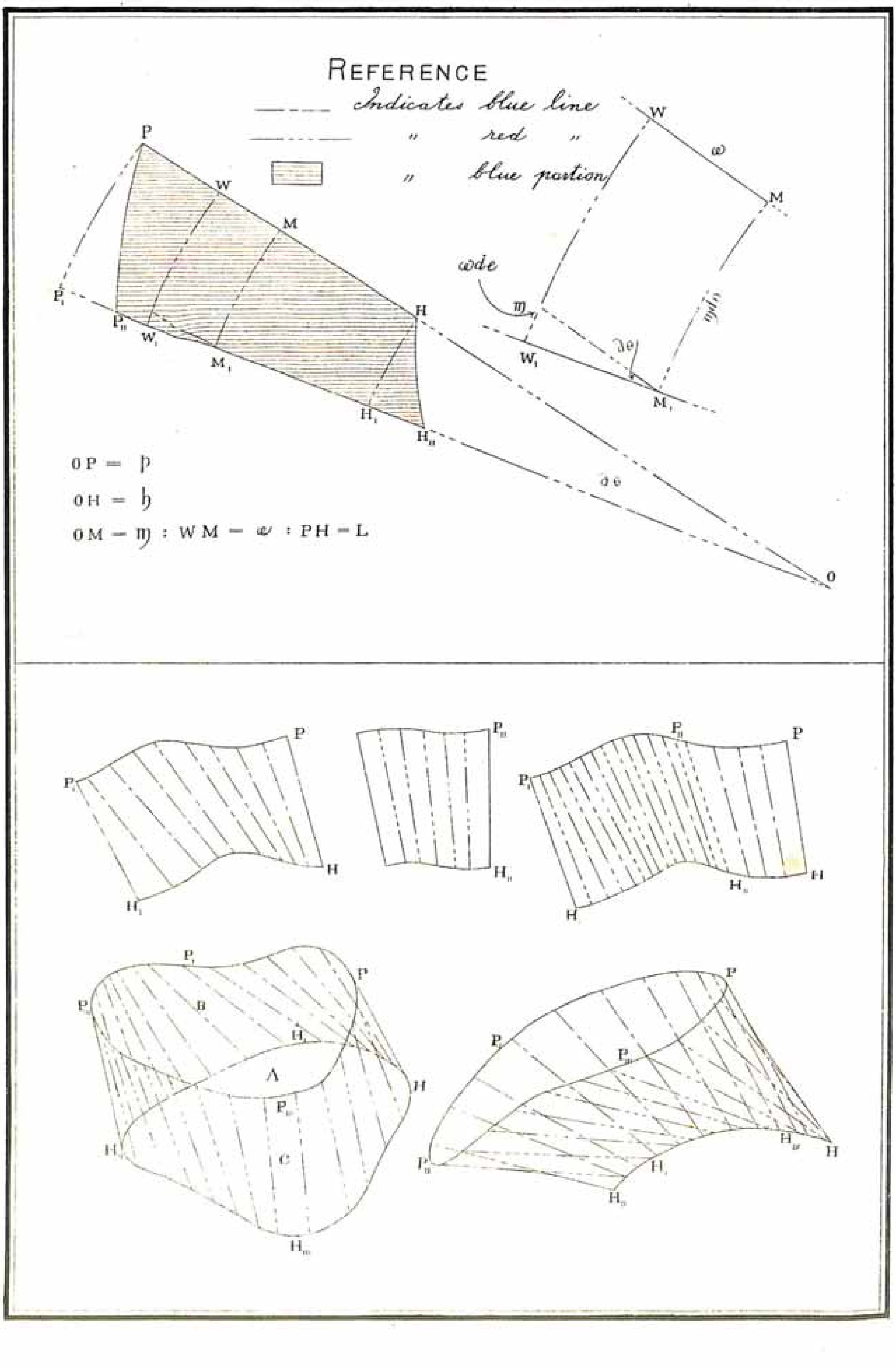
In conclusion I would seek to claim no particular credit for this simple invention which merely draws attention to possibilities which were already in Amsler's Planimeter in a latent and not generally appreciated form.

If is my hope that my remarks may lead to a better understanding of the principles of the instrument and a fuller appreciation of the beautiful simplicity of Dr. Amsler's most marvellous and indispensable invention.

AREAS REQUIRED IN □′			
Scale		*Setting*	*Multiplier*
$\frac{1''}{16} = 1'$	$\frac{1}{192}$	31. 25	1000 ÷ 2
"	"	18. 75	300
$\frac{1''}{8} = 1'$	$\frac{1}{96}$	25	100
$\frac{3''}{16} = 1'$	$\frac{1}{64}$	28. 12	100 ÷ 2
"	"	18. 75	100 ÷ 3
$\frac{1''}{4} = 1'$	$\frac{1}{48}$	20	20
"	"	40	40






REFERENCE
Indicates blue line
" red "
" blue portion
OP = p
OH = h
OM = m : WM = w : PH = L
P
W
M
H
O
A
B
C

A MODERN BATTLESHIP AND HER ENGINEERS.

By

A. R. Pattison Esq., R. N.

The subject which I have ventured to bring before you is probably a familiar one to most of those present, but knowing the country which at present I have the honour to serve is steadily working towards that zeal where for the production of her various necessities, even battleships, she can look to her own resources, I hoped by drawing attention to the comprehensive nature of this huge machine, for such is the nature of the present day battleship, which is ultimately evolved from the many hours mental labour of many individuals, to bring its designers as much as possible in sympathy with those who have to manipulate this huge machine and keep it in as efficient a state as possible so that when considering the arrangement and design of its many details they may always endeavour to make them of as simple a character as possible with a view of reducing to some extent the very onerous duties of those in charge.

I fear the fact of certain things or arrangements having answered alright in the past often bars the path of progress, but if at the start of his designs the Naval Architect realises the difficulties of those who will have to make use of this machine, we shall have already made some progress towards simplification. Undoubtedly these are already realised in a large measure by all Naval Architects and we may infer that as the various directions in which this may be done become apparent to them so this progress will continue.

The duty of keeping this huge fighting machine in an efficient state is necessarily the business of both the Military and Engineer officers of the ship, though in its thousand and one mechanical features it falls more to the duty of the latter from the fact of his greater mechanical knowledge than the former officers and the Engineer officer from this very fact probably looks upon this duty in a more serious manner than even the Captain of the ship though in the latter the whole responsibility of the ship is vested.

First and foremost we know a battleship in a fighting machine and in this character paractically the two most important elements to be kept in an efficient state are:—

1. The Motive power.
2. The Offensive power.

but correlative with these in the day of battle are may minor yet important features, upon the efficiency of which the safety and hence to a more or less extent the defensive powers of the ship depend such as:—

3. The Watertight Doors, Scuttles &c.
4. The Fire Arrangements.
5. The Arrangements for Flooding Magazines &c.
6. The Arrangements for Flooding
   (a) Double Bottoms
   (b) Wing Compartments
7. The Arrangements for Draining and Pumping out (a) Compartments above the Double Bottom.
   (b) Wing Compartments.
   (c) Double Bottom.

8. The Automatic Valves in connexion with the Ventilating Arrangements.

It is probably the habit of the uninitiated to look upon the defensive powers of a ship as represented by so many inches of side armour or armoured deck, but though these particular items undoubtedly constitute the primary elements of defence yet once these have been successfully attacked by shot or shell, some portion of the other items mentioned will probably at once come into requisition and upon the particular efficiency of that part the safety of the whole ship may depend.

As to the shot or shell being kept out of the ship by her armour or not, this is we may say "The fortune of war" and is altogether beyond the powers of the crew of the ship to in any way influence, other than the ship being unnecessarily exposed to the enemy's fire; but as to the other points this is to a large extent in the hands of the officers and men, I say to a large extent as of course these are good and bad arrangements in all things and it may happen that the particular ship has not been well fitted in the particular part where the injury is located or notwithstanding the greatest fore thought having been exercised in making the arrangement the usual unforeseen happens. This brings us to the "human element" and it is here that the weak point in every ship is to be found and it is with a view of pointing out the necessity of taking as much of this weakness as possible out of the reach of this factor that is the "eliminating of the human element" as much as possible that these few remarks are written.

Now the designers of the ship and its various internal arrangements consider each particular arrangement in turn and arrange its various details to meet the functions which it has to perform, but do they always consider that when the ship is in commission the knowledge of the whereabouts and mode of working all these details is necessarily confined to a comparatively few individuals.

Only those who have had much to do with large bodies of men, and by men I mean here the class which form the actual crew of the ship, will realise what a small amount of intelligence one often meets with and how notwithstanding repeated drillings, the last thing happening out of the normal result of these drillings is for the moment lost and chaos reigns until a lead is shown by some one better gifted in that direction and moreover as each individual unit of the crew must necessarily be told off to a particular station or stations it follows that the knowledge of all these arrangements must be centred in some few individuals. and considering the ship herself and her multitudinous mechanical details, for the reasons referred to before these practically devolve on the Engineer Officer in charge and his Subordinates. Also from the fact that most of these latter officers have only been a comparatively short time in the service and have therefore had little experience the responsibility for all or even any large portion of these items cannot be put upon or expected from them, hence the number of individuals is further reduced who should have an intimate knowledge of the various details of what go to make up a Battleship.

Considering the items mentioned more or less in detail :—

Motive Power. 1. *Motive Power.* Without in any way touching the subject of what the speed of a Battleship should be, yet as the speed of a squadron is that of its slowest ship, it follows that the most essential duty of the Engineer Officers of the ship is to keep the Propelling Machinery in such a condition that the Captain of the ship or Admiral in Command of the Fleet should be able to rely on her realising, at any rate approximately, her original speed when the necessity arises—neglecting of course such items as cleanliness of bottom &c.

The work and responsibility envolved in the endeavour to keep to this state of efficiency are in many cases greater than the most liberal mind, outside of the engineering branch, would imagine; it only needs a very casual look around the Engine and Boiler Rooms to in some measure impress one with its magnitude. The work done in making good the defects which arise from fair wear and tear is alone considerable, but to ensure the Machinery and Boilers being in and is kept in our ideal condition constant examination of all parts must be carried out. The Naval Architect will wonder probably in what way this concerns him, only that he has a way of always asking for the "Maximum Indicated Horse Power on the Minimum Weight and Space". Had this requirement not been met to the best of his powers by the Engine Designer, some recent developments of Naval Science could never have been produced, I refer especially to the Torpedo Boat Destroyer, but in many cases the reasons are certainly not apparent to the engineer why his Department should have been so limited in extent in the original design. A few feet more may make all the difference as to the accessibility of some particular parts of the Machinery etc. and at times I am sure that the difficulty of getting to such parts lead to their neglect and inefficiency.

Further how often this limitation of space makes parts of the bilge &c. very difficult to get at for cleaning and examination, yet what a large influence a dirty bilge may have on the health of the crew.

Also apart from the large amount of work involved in keeping the actual propulsive Machinery and Boilers efficient, there are the numerous auxiliary engines in direct connection with them which each tends to add or detract from the general efficiency unless duly looked after.

Offensive Powers. 2. *Offensive Powers*:—Here we have the Main Armament as comprised in the largest guns; the Seconday Armament; and the Torpedoes.

The Ram when once built into the ship is practically finished with until it is actually made use of for ramming purposes.

In action the manipulation of these offensive powers necessarily falls to those whose training is of a more military character than could for the benefit of the Naval Service be given to those whose time is necessarily devoted to learning an already wide profession. The guns are under the sole charge of those who use them, but their Mountings excepting in the case of the Secondary Armament is only looked after by the Military Branch as regards cleanliness. As for the Mountings of the Secondary Armament, practically they are under their entire control, though even here the engineer officer shares the responsibility for their condition and joins in the examination of the parts of the mountings and should any considerable defect be discovered or sustained by the mounting then its repair devolves upon him the mechanical officer.

The Main Armament, which for any degree of rapidity of fire whatever is out of the range of hand power, though this is now usually provided as an alternative in case of the damage of the primary power considerably adds to the Mechanical appliances to be kept in a high state of efficiency. At present the more general means adopted for working the heavy ordnance is hydraulic power, though electricity has been fitted as an alternative mode and in the French Navy even as the primary power.

As-uming our primary power to be hydraulic we have, in addition to the 2 Main and 1 small Auxiliary Hydraulic Engines themselves, in a ship of say the "Majestic" class no less than 32 other hydraulic motors such as turret or barbette turning engines, lifts, bollards &c. to be looked after as well as the many very important parts in direct connection with the gun mountings and barbettes. With regard to the latter, difficult as the problem envolved is, as any increase in space made available for these guns and their mountings means so much in other directions such as increased weight of armour with its many attendant considerations, yet the easier the making of an examination or repair of the various parts of these large mountings is made so will their efficiency be the better assured for though the designer may take care that all parts are accessible for examination, yet the difficulty of the situation may lead to such an examination taking so long and the conditions of the service upon which the ship is employed may be such that the Captain of the ship may not see his way clear to granting the necessary time unless these are known reasons for working it absolutely necessary and defects which may possibly exist remain undiscovered.

The Torpedoes, of course excluding the Mines of which the Military Branch have sole charge, each require most careful attention to keep them the deadly weapon which they should be—a faulty adjustment may make the torpedo more dangerous to its friends than its adversaries.

Then they have to be provided with their Motive power viz. compressed air, for which there are generally 4 Air Compressing Engines and then the Tubes for discharging the Torpedoes from the ship, now consisting nearly wholly of the Submerged Type viz. 4 out of the 5 with which Battleships are now usually fitted, are each of them of a construction needing both care and attention.

In a ship of the "Majestic" class there are no less than 72 Auxiliary Steam Engines of various sorts, the majority of which are essential, some primarily so to the use of the two items we have been considering, these latter comprise the Steering Engines, Dynamos and their Engines outside the Engine Room Department whilst the number in use for the Machinery and Boilers is regulated by the actual power required. Speaking of the Dynamos and their Engines one may almost look upon these as bearing a decided influence upon the Offensive and Defensive Powers of the ship as we find a considerable use made of them for working electric-motors for the rapid supply of Ammunition and as already mentioned they are in many cases utilised for working motors as an alternative power for the Main Armament, whilst the benefit arising generally from having all parts of the ship and its mechanism well lighted does not need calling attention to. As a defensive agent we utilise them for the electric search light for warding off Torpedo Boat attack, without it the ship becomes a much easier object for them.

So far we have only touched upon our two primary items yet from these alone it is very clear what an important part the engineer plays in this magnificient structure being the efficient fighting machine that she is supposed to be and yet we have not come by any means to the end of what his personality may do for or against this, for proceeding with our other items:—

W. T. Doors &c.

3. *W. T. Doors, Scuttles* &c. With a view of localising the effects of any injury which the ship may receive, she is subdivided by her decks, bulkheads—longitudinal and transverse, into as many compartments as possible, consistent with the other requirements of the ship. Many of these compartments containing stores and gear which are not necessarily in use when the ship is in action and may be kept closed, but a very large number and those the largest in cubic capacity, contain the various means of offence and defence and ready access to these must be provided. The question of the degree of accessibility to be provided is a much discussed one, but in all cases it has to be provided to a greater or lesser extent, whilst the continuity of the bulkheads &c. is made by means of the watertight doors and should these not be in a thoroughly efficient state, two compartments whose combined capacity would altogether destroy the bouyancy of the ship may to all intents and purposes be made common.

When you consider that in a ship of the "Royal Sovereign" class, there are 33 separate compartments in the Double Bottom, to which there are 70 manholes made in the inner skin each of which must be properly closed; 44 separate wing compartments and between the Main Deck and Inner Bottom there are no less than 136 Compartments and spaces, the whole of which are made use of in some way or other and therefore have to be provided with W. T. Doors of sorts to effect their watertightness and that the Number of these doors is no less than 243 of all classes viz:—

Ordinary Water Tight Doors		
1. Hinged—Vertically		126
do.	Horizontally	36
2. Sliding—Vertically		18
do.	Horizontally	5
Armoured W. T. Doors—Hinged and	Sliding	32
Moveable Covers, secured by clips		26
	Total	243

Some idea may be gathered of what a very important item the efficiency of the watertight doors etc. of a ship is and the necessity of their being in proper working condition, the ensuring of which can be greatly facilitated by the Naval Architect in taking care that the door selected is rapidly, surely and securely shut and that in the case of sliding doors the leads of the gearing for closing from deck positions are the most direct obtainable, that the parts of the bulkheads to which these leads are attached are as rigid as possible, that the workmanship is good and though properly cased in exposed positions yet accessible for cleaning, etc.

Of course the filling of a Double Bottom compartment or even several or some of the compartments included in our 136 above would have a comparatively small effect as regards endangering the safety of the ship but the case to be considered must be that of the large compartments and a little extra time and money expended in giving the highest class of work is well laid out.

Fire Arrts.

Fire Arrangements. The importance of an efficient fire arrangement every one that has had anything to do with ships will readily admit, its importance in actual battle to a modern warship is probably better known by the Japanese Officers who took part in the various Naval Engagements in the War with China than any others of us present.

The providing of the means of dealing with a fire is by no means a difficult problem, neither is the keeping of those means in an efficient state, certainly it means the keeping of a certain number more pumping engines, Downton pumps and perhaps 35 to 40 more stop valves in good order, but from an action point of view the best fire arrangement is for these to be the absolute minimum of inflammable material present, as though our fire arrangements and organisation may be perfect yet as fires are more likely to occur in the exposed positions on a warship, the men necessarily have to be exposed in extinguishing them and as in action the brigade manning the hoses from the Engine Room pumps are usually stokers, a loss of men here robs two places as it were of their complements and by reducing the available labour in the Engine Room Department the power of maintaining that primary item—Speed, is affected.

There is one point however that should not be lost sight of in arranging this fire Main and that is the positions of the Master valves to the various rising Mains, these or the gearing for working them should be placed in accessible positions as when the ship is in action, with all doors closed that are not absolutely required to be open, should a fire or fires occur, whilst at another part of the ship the rising main is shot away, the latter injury may cause the loss of so large a volume of water from the firemain as to leave a practically small quantity for fires and whilst some one is getting to the master valve to the injured rising main unless the shutting-off position be readily accessible the fire or fires may assume serious proportions.

Flooding Magazines.

5. *Arrangements for Flooding Magazines &c.*

This is practically a part of the Fire Arrangements as it is only in the case of fire that the necessity of flooding these to ensure the safety of the ship arises. Its complexity depends practically on the number of magazines &c. but in the classes of ships we have referred to the number of compartments to which Flooding Arrangements are fitted is about 18 and to actually flood these apart from the Main Kingstons, from which the supply of water is obtained direct and which are also used for other purposes there are roughly 23 Valves, the working positions of which must be accurately remembered, the majority of these valves are workable from 2 positions and to present the possibility of their being tampered with they are locked at each position.

Flooding & Pumping Arrts.

6 & 7. *Flooding, Draining and Pumping Arrangements.*

Considering these together for the sake of brevity and also a ship of the "Royal Sovereign class.

It is unnecessary here to go into the mode in which the various operations are performed, excepting to state that to effect them we make use of the Kingstons to the various Downton pumps, the Downton pumps, the Main Drain, Main Suction, and Steam Pumping Engines. What I desire to draw attention to however is the number of valves of various sorts in these arrangements e.g.

In the Main Suction there are...7 sectional valves
In the Main Drain there are...6 sectional valves
For Flooding Double Bottoms
there are...45 Valves of sorts
For Flooding or Draining Wing
Compartments...24 — do. —
For Draining the 136 Compts. within the ship } about 125 — do. —
For Pumping out Double Bottoms...22 — do. —

In addition to which are the valves common to the performance of several of the above.

The means of opening each of these has to be led to some accessible position, with which and the correct sequence of valves to open to attain any desired objective, the senior engineer officers at least must be thoroughly acquainted, as it may be of the utmost importance at some time or other to flood or drain some compartment or compartments expeditiously e.g. In action the ship may be damaged on one side sufficient to put several of her wing compartments in direct connexion with the sea which though not endangering her buoyancy yet gives sufficient list to make the working of the guns, especially the large ones a matter of extreme difficulty, or it may be that from the ship having been some time at sea she is considerably above her normal draught so that this list brings the lower edge of the armour dangerously near the Water Line to meet either case it becomes desirable to flood compartments on the other side of the ship or the damage may be right forward putting her down too much by the bow to overcome which it is necessary to flood the after Double Bottoms.

Or it may happen that whilst the bulkheads to some one compartment are badly damaged, those to the adjacent ones are considerably less so and the pumping power of the ship is able to cope with the leakage of all but the badly damaged compartment, in such a case the question of whether the ship can be kept afloat or not may entirely depend on the situation being quickly and properly dealt with and the various pumping systems being in an efficient condition.

Ventitn Arrts.

8. *Ventilating Arrangements.* Necessary as the ventilation of the many compartments of a ship is, yet it is the inherent source of a considerable amount of danger notwithstanding the fact that Automatic Valves are fitted wherever the various trunks pass through W. T. Bulkheads or connect in any way 2 W. T. Compartments. The actual danger is with these very valves, they act well so long as they are kept in good condition, but a valve neglected through its being in some comparatively inaccessible position may at the desired time fail to act and thus be the means of flooding several other compartments and jeopardising the safety the ship.

To meet the actual necessities of the ventilation of a ship of the "Majestic" class we find that there are no less than 80 automatic valves and 27 screw closing sluice valves in the supply trunks alone.

The Automatic Valves are arranged in groups so that they can be closed by flooding through small pipes from the Main or Upper Decks, but necessarily these numerous small pipes pass through exposed positions and the accidental squeezing in of one would mean unless the valve were closed by hand its remaining open until the water came to it through the trunk and except in the case of closing by hand there still remains the possibility of the Automatic gear not acting.

Although we have only taken a cursory glance at some of the many items which go to make up the whole of this structure I think sufficient has now been said to shew the magnitude of the work and responsibility of those who are in charge and as I have already pointed out its very complexity puts it beyond the intelligence of the average unit of the crew to grasp more than some particular portion and in most cases a very small portion, of the whole, consequently though by judicious subdivision of labour we get the whole properly looked after, yet the general supervision is necessarily confined to a very limited number of individuals and moreover it is only after a considerable lapse of time and labour that these get to have any complete knowledge of their ship, consequently the desirability of their remaining in them for lengthy periods is apparent, as, assuming they are capable and zealous officers it must be to the benefit of the ship and the service, and should the necessity arise for changes to take place, care should be taken that a fair proportion of those who may reasonably be expected to know the ship are left until the new comers have had ample time to learn this complicated structure.

That every endeavour is being made by our Naval Architects to simplify this structure and also to adopt uniform and symmetrical arrangements we are fully aware. In doing this they are in every way adding to the efficiency of the ship as not only does this lead to cheapness and rapidity of construction but the respective details are more efficient in their action and what is of probably more importance their positions and the positions from which they are worked are easier remembered, with the result that a larger number of individuals become acquainted with the ship and our unit is able to grasp the details of a much larger portion. And here the great advantage of uniform types of ships is at once apparent as the experience gained in one is available for all of the class and if this question of uniformity could be in a measure followed not only in ships of the same class but in the arrangement of many of the details in those of other classes we should be gradually eliminating the weak element of our structure viz "the human one" by his experience making more or less of the Automatic Machine of him.

I have only been able here to touch on some of the more important items which go to make up the day's work in a modern Battleship as apart from the many things in the Actual Engine Department to which we have not even referred, there are many other items outside, which are still important as regards the internal economy and efficiency of our ship for instance!—Drinking Water arrangements, Steam Boats of which there are generally 3 or 4, together with the necessary engines for hoisting them in and out of the ship; coal Hoists and in fact numerous other things which we have no time to touch on.

It is only by bringing our facts together a little as we have been doing here that any correct idea can be gathered of the amount of responsibility some of the individuals on our large Men-of-war have to undertake, also the large amount of thought and foresight which they have to exercise to see that their ship is a thoroughly efficient fighting machine.

To us of the non-military branch it is not given to bring down on ourselves individually the glory which is the hope and aspiration of our brother officers of the Military line, that which we get is more or less *reflected* glory, which comes to us from our Captain having found everything as efficient as human endeavour could make it when the day of battle comes, and in the future I hope it will be fully realised what a very important part the engineer officers have taken in ensuring this success and how earnestly, quietly and loyally they have done their duty.

○船舶ノ大小及速力ト積載量ノ關係

會員　辰巳一

エー私ハ本會ノ發起人ノ一人デゴザイマシテ無論本會ノ趣意ヲ賛成シテ居リマスコトハ能ク分ッテ居ル話デゴザイマス、殊ニ今日設ケラレマシタ此講演會ハ初會デモアリマスシ何カ講演ヲ致シタイト考ヘテ居リマシタケレドモ兎ニ角公務ガ多忙且又無學デアリマスカラ到底講演ハ今年ハ出來ヌ、諸君ノ講演ヲ清聽致ス考ヘデアリマシタ處ガ造船協會カラ突然今年ノ講演會ニ於テ講演ヲスル講演者ノ内ニ名前ヲ加ヘテ置イタ故何カ講演ヲセヨト斯ウ云フ殆ンド命令的ノ通知ヲ得マシテ、ソレデ時日モアリマセズ到底充分ナコトハ出來マセヌケレドモ唯ダ造船技術官トシテ何カ演説ヲ致ス積リデアリマス、併ナガラ迚モ諸君ノ御參考トナルベキモノデ無イ事ハ前以テ御斷リヲ致シテ置キマス、

ソコデ我カ帝國ハ數箇ノ島ヲ以テ成テ居ル海國デゴザイマスカラ內國ノ運輸交通ハ勿論世界各國トノ通商貿易ハ皆此ノ船舶ニ依ラネバナラヌコトデアリマス、近頃ニ至リマシテ我國ノ運輸社會ハ大ニ其ノ航路ヲ擴張シマシテ船舶ノ數モ增加致シテ益々隆盛ニ赴クノ勢ヒデアリマス、處ガ二十年以前ニ在リマシテハ一個人トシテ汽船ノ持主タルモノモ極メテ僅少デゴザイマシタガ近年ニ至リマシテ大ニ其ノ數ヲ增加致シマシタ、併シナガラ近年マデハ夫等ノ多クハ我國ノ沿岸又ハ朝鮮支那海ノ間ヲ航行スル位デアリマシタガ我國ノ事業ノ發達スルニ從テ歐米ニ航路モ擴ケル樣ニナリマシテ今後益々船舶ノ數ニ於テ一大增加ヲ見ルコトデアラウト信ジマス、ソレデ今日此會ニ於キマシテハ船舶ノ大小ニ依リ又其ノ速力ノ遲速ニ依リ貨物ノ積量ニ及ボス所ノ關係ヲ陳ベマシテ聊カ運輸營業社會若クハ船主諸氏ノ參考ノ一端ニ供ヘ樣ト思ヒマス、

第一項トシテ貨物ノ積量ト速力トノ關係ヲ述ヘマス、

貨物ノ積量ハ船體ノ大ナルニ從テ增加スルコトハ當然ノコトデゴザイマスガ又速力ノ如何ニ因テ增減アルヲ免カレマセヌ、抑モ此速力ヲ大キクシヨウト爲マスレバ機關ノ力ヲ增サナケレバナリマセヌ機關ノ力ヲ增シマスレバ隨テ其ノ重量ガ增シマス故ニ機關ノ重量ト云フモノハ速力ヲ三乘シタモノニ比例シマスルカラシテ貨物ノ搭載量ハ其ノ反比例ヲ以テ輕減セラル、譯合デゴザイマス、假令ハ爰ニ一千五百噸積ニシテ速力十三海里ノ船ガアルトシマシテ夫レニ一時間十五海里ノ速力ヲ與ヘマスニ適當ナル機關ヲ備ヘマスルニハ一千五百噸ノ積量ハ$\left(\frac{13}{15}\right)^3$ノ割合ニ輕減セラレマシテ九百七十五噸積ト爲リマス即チ五百二十五噸ノ差ガ顯ハレマス之レガ速力ト積量ノ關係デゴザイマス、

第二項トシテ船體ノ大小ト積載量トノ關係ヲ述ヘマス、

此ノ關係ニ就キマシテ技術上ノ學理ニ依リ説明ヲ致シマスル爲メニ先ヅ一ノ例ヲ擧ケマスルト云フト、

玆ニ一ノ汽船ガゴザイマシテ其ノ排水量ヲDト致シマシテ之ヲ分拆致

シテH、E、Cノ三種ノ重量ト爲シマス、

Hハ船殻ノ重量ヲ主トシテ其他船殻寸度ノ大小ニ因リマシテ比例的增減スヘキ各種ノ物品ノ重量ト致シマス、

Eハ機關ノ重量ヲ主トシテ其他石炭等デゴザイマシテ機關ノ實力ニ因テ比例的增減スヘキ各種物品ノ重量ト致シマス、

Cハ前二種以外ノ搭載物ノ重量ト致シマス但シ其ノ大部ハ貨物ヲ以テ占ムルモノデゴザイマス即チ C=D−H−E デゴザイマス、

今右ノ船ヲ一層大キク致シマスル爲メ船體各部ノ寸法ニ一位以上ノ一定ノ率ヲ乘シマシテ一ノ新船ヲ建造致サントシ前者ト同一ノ速力同一ノ航海力ヲ保有セシメマスルニ足ルヘキ機關及ヒ石炭其他ノ消耗品等ヲ備ヘル計畫ト致シマスルト排水量其他前述H、E、Cニ對スル新船各種ノ重量ハ斯樣デゴザイマス、

$$D_1=Dm^3 \quad H_1=Hm^3 \quad E_1=Em^3$$

$$(イ)\ C_1=(D-H)m^3-Em^3>(D-H-E)m^3\ 或ハ\ >Cm^3$$

mト云フノハ船體各部ノ寸法ニ乘シタル一定ノ率デゴザイマス、

此ノ算式ノ示シマス通リ船舶ノ積載量ハ $(m)^3$ ノ割合ヨリモ一層長足ヲ以テ增加スルモノデゴザイマス、之ヲ換言シマスレバ船體ノ大ナルニ從ヒマシテ比較的ニ貨物積載量ノ强大ナルコトガ知レマス殊ニmノ大ナル程其ノ差ガ最モ著シイデアリマス、

今前述ノD、H、CmヲAノ如ク致シマスルト

$$D=5000 \quad E=1000 \quad H=2500 \quad C=1500$$

$$m=1,26$$

デ、新船ノ爲メニ得マシタ D_1 H_1 E_1 C_1 ハ左ノ如クニ爲リマス

$$D_1=10000 \quad E_1=1587,6 \quad H_1=5000$$

$$C_1=3412,4$$

ソコデ甲ノ船ノ各部ノ寸法ニ 1,26 ノ割增ヲ致シマスルト其結果トシテ乙ノ船ノ排水量ハ二倍ト爲リマスケレドモ貨物ノ積載量ハ二倍以上即チ 2,274C ノ割合ト爲リマス故ニ大キナ船ヲ以テ利益ガ有ルト爲ル譯デアリマス、

猶ホ一層之レヲ明瞭ニ致シマス爲メ前述ノ甲船ヲバ漸々其ノ排水量ヲ增加致シマシテ(イ)ノ法定式(イコハイシヨン)ニ依リマシテ貨物ノ積量ヲ算出シマシテ一ノ曲線ヲ畫キマスルト此ノ圖ノ中ノC^1ナル稍々直線ニ類似シタル曲線ヲ得マス、又圖ノ中ノ點線C^2ト云フノハ貨物ノ積載量ヲ單ニ排水量ニ比例スルモノト假定シマシテ即チ(ロ)ノ法定式(イコハイシヨン)ニ依テ得タル純然タル一直線デゴザイマス

(ロ)　$Y=Kx$

Yハ貨物ノ積載量デ $K=\frac{C}{D}=\frac{1500}{5000}$、$x$ハ排水量デゴザイマス

此ノC_1 C_2 ノ二線ヲ比較致シマスルト船舶ノ大ナルニ從ヒ其ノ積載量ニ於キマシテ比較的著ルシキ增加ノアルコトガ知レマス、假ヘハ排水量一萬五千噸ノ船デゴザイマスルト貨物ガ五千四百二十一噸ヲ積ミ

マス又タ排水量一萬二千噸ノモノデ四千二百七噸ノ貨物ヲ積ムコトガ出來マス、然ルニ此ノC_2ノ線ニ依リマスルト一萬五千噸ノモノデ僅カニ四千五百噸、一萬二千噸ノモノデ三千六百噸ヲ積ムニ過ギマセヌ即チC_1ノ線ニ依リマスレバC_2ノ線ニ依リマスルヨリハ一萬五千噸ノモノデ九百二十一噸、一萬二千噸ノモノデ六百七噸ノ割合ニテ多量ノ貨物ヲ積載スルコトヲ得マス、

又此ノ圖ニ示シマスル如ク一萬五千噸ノ船一艘ハ一萬噸ノ船ト五千噸ノ船トノ二艘ノ積載量ヲ合セタルモノヨリモ尙ホ五百九噸ノ多量ヲ積ミ一萬二千噸ノ船一艘ハ七千噸ノ船ト五千噸ノ船トノ二艘ノ積載量ヨリモ多ク積ミマスルコト四百五十九噸デゴザイマス、

右ノ如クデアリマシテ大船ノ愈々利益アルヲ知ルニ足ルコト、存ジマス故ニ世界各國ノ汽船會社ハ爭フテ各々其ノ經濟ノ範圍内ニ於キマシテ及フベキ丈ケ大キナ船ヲ製造スルコトニ努メテ居リマス、此ノ大船ノ利益ト云フモノハ積量ノ多寡ノミデハゴザイマセヌ船體ガ大キウゴザイマスルト航海ガ安全デ船客ノ信用モ得マスル自由便利ナルガ上ニ天候ノ如何ヲ顧ミズニ航海ヲ期スルコトモ出來マス加之船員モ割合ニ多クヲ要シマセヌ等種々ノ點ニ於キマシテ尠ナカラヌ利益ノアルコトデゴザイマス、

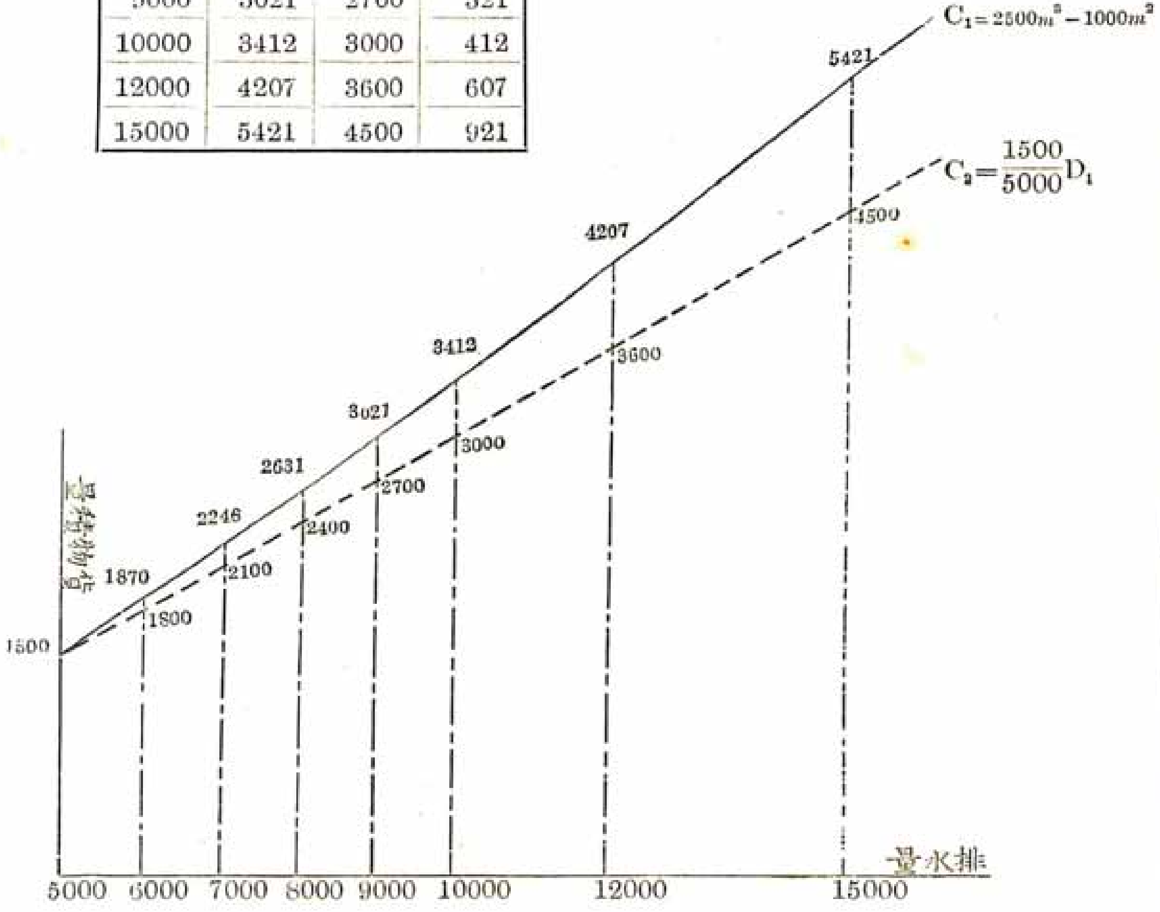
我ガ郵船會社ニ於キマシテモ近來大船ノ利益アルコトヲ感セラレマシタ故デアリマシヨウ神奈川丸土佐丸河内丸ノ如キ從來東洋ニ於テ見ザル處ノ大船デアリマス、又獨逸ノきーるニ於テ製造シマシタ米國通ヒノ滊船デかいざぁうぇるへるむでるくろすト云フ如キハ近世ノ大汽船デアリマシテ彼ノ海上ノ怪物ヲ以テ稱セラレタ英船ぐれーといすて！るニ亞クモノデアリマス、其ノ噸數ハ二萬噸ニ達シマシテ全長六百四十八英尺馬力ハ二萬七千速力二十二海里半船客一千五百人ヲ容ル、ニ足ルト申シマス此ノ外ニ一萬七八千噸位ノモノモ亦タ尠ナクハゴザイマセヌ、此等ノ大船ハ固ヨリ特別ノモノト致シマシテモ世界ノ趨勢ノ大船製造ニ傾キタルハ疑ヲ容レザル處デアリマス、

以上陳ヘマシタル處ハ事新ラシク此講演會ニ於テ吐露致シマセズトモ大畧世上ニ知レテ居ルコト、存ジマスレドモ聊カ之ニ技術的ノ學理ヲ加ヘマシテ技術者以外ノ當事者諸君ノ參考ニ供ヘント思ヒマシテ敢テ蕪辭ヲ陳ヘテ諸君ノ淸聽ヲ煩ハシマシタルハ深ク謝スル處デゴザイマス、

貨物積載量曲線

比較表

船舶排水噸數	貨物積載量 C_1	貨物積載量 C_2	C_1-C_2
5000	1500	1500	0
6000	1870	1800	70
7000	2248	2100	148
8000	2631	2400	231
9000	3021	2700	321
10000	3412	3000	412
12000	4207	3600	607
15000	5421	4500	921



Scale $10^m/_m=1000$

○船舶製造上ノ統計ニ就テ

會員　佐雙左仲

私ハ今日講演ヲ致ス積リデハゴザイマセンデシタカラ前以テ其ノ通告ハ致シマセナカツタノデスガ時間ガアリマスレバ極ク詰ラヌコトデアリマスケレドモ少々申上ケタイト存シ唯今會長閣下ニ申上ケテ許シヲ得タ樣ナ次第デゴザイマス、私ノ申スノハ極ク詰ラヌコトデアリマスルガ又タ船デモ製造ナサレタリ豫算デモ編製ナサル、諸君ニ對シテ幾分カノ參考ニナラウカト考ヘマスルノデ簡單ナガラ申上ケマス、

私ガ英國ニ於キマシテ造船ニ從事シマシテ日本ヘ歸テ來マスルト云フト造船會社其他海軍ノ造船所ニ於キマシテモ總テ何事モ統計ト云フモノガ甚タ不充分デアル、之ガ甚タ遺憾ナ譯デアツタト云フコトヲ考ヘタノデアリマス此ノ造船業ノ如キモノハ統計ヲ能クセヌト云フト到底行ハレルコトデナイノデアル、既ニ豫算ヲ作ルト云フテモ前ニ作ツタモノガ充分ニ分ツテ居ラナケレバ到底出來ルモノデナイ又タ一ツ船ヲ計畫スルノニモ是マデノ計畫ガ何ウ云フ結果ヲ呈シタト云フコトモ知ラナケレバナラヌ、夫レモ調ベテ無イ、偖一ツ船ヲ造ラウトスルニ是マデノ船ハ何ウシテ出來タカト云フト何ニモ書イタモノガ無イ、サウスルト愈々事業ハ新規ニ遣ツテ往ク樣ニナツテ非常ニ骨ガ折レルノデゴザイマス、ソコデ夫レデハ到底船ノ計畫ヲ爲シ且又タ造船事業ヲスル人ハ非常ニ是カラ不便デアラウ、ヂヤニ依テ海軍ノ方ニ於テハ統計ヲ充分ニセニヤナラナイト申シテ二十五年ニ私ガ横須賀ヨリ海軍省ヘ轉職致シマシテ、夫レカラ海軍ノ規則トシテ此ノ統計ヲ爲スコトヲ達セラレタ事ニ致シマシタ、夫レカラ其ノ達セラレタ前ニ秋津洲ノ製造ニ於キマシテ私ガ主ニ爲ツテ宮原君ガ機械ノ主ニ爲ツテ居ラレマシタノデ其ノ統計ヲ先ツ以テ取リマシタ、之ハ達シノ出ル前ノ事デアリマシテ極ク確カナモノトハ申サレンケレドモ今日ニ於テハ幾分カ夫レガ參考ニナラウト考ヘマス、夫レカラ須磨ノ頃ニハ最早達シノ出タ後デゴザイマシタカラ今日代價等ノ統計ガ皆出來テ居リマス、夫レデ今之レヲ長タラシタ申上ケタ處ガ數字ノ事デアリマスカラ到底御記憶ニ爲リ難イト思ヒマスカラ茲ニ掲ケマスル別表ニ就テ御覽ヲ願ヒタイ、ガチヨツト其ノ大要ヲ摘ンデ申シマス、

先ツ以テ秋津洲ハ計畫ノ排水量ガ三千百八十九噸デゴザイマシタガ實際ニ於キマシテ三千二百十八噸凡ソ二十九噸增シテ居ル、須磨ハ二千七百噸ノ計畫デアツタノガ夫レガ二千八百噸凡ソ百噸ノ超過デアル、又タ喫水カ一吋沈ムノニ何レダケノ噸數ヲ要スルカト云フト秋津洲ハ二十一噸八六須磨ガ二十一噸六七デアリマス、サウスルト秋津洲ニ於キマシテハ殆ント平均一吋半須磨ニ於キマシテハ殆ント平均五吋沈ンデ居ラウト思ヒマス、又タ兩艦ノ重量ヲ調ベテ見マスルト秋津洲ニ於キマシテハ船殼ノ重量ト云フノガ千百九十七噸須磨ニ於テハ千六十五噸夫レカラ中ノ雜作ノ重量カ幾ラカト云フト秋津洲ニ於テ二百三十二

噸須磨ニ於テハ二百四十九噸其他齊備品之レハ何ガ合シテ居ルカト云フト乘組人員並ニ所持品、淡水、水罐、糧食並ニ其ノ風袋、倉庫品、檣、圓材並ニ索具、錨、錨鎖並ニ屬具、端舟、汽艇、サウ云フモノヲ稱ヘテ齊備品ト稱ヘル之レガ秋津洲ニ於テ二百二十三噸須磨ニ於テ二百十八噸、夫レカラ防禦甲板ノ重サガ秋津洲ニ於キマシテ三百二十六噸須磨ニ於キマシテハ要領書ニ就テ御覽ノ通リ餘程薄ウゴザイマスカラ百三十九噸デアル、夫レカラ司令塔其他揚彈路裝甲ノ重量ト云フモノガ秋津洲ニ於キマシデハ三十噸須磨ニ於キマシテハ六噸之レハ揚彈路ノ裝甲ハ須磨ニハアリマセヌ、夫レデ船體部ノ重量ガ秋津洲ニ於キマシテハ二千八噸夫レカラ須磨ニ於キマシテハ千六百七十七噸斯ウ云フコトニナル、夫レカラ機關部即チ駛船汽機補助機械等ガ秋津洲ニ於テハ三百三噸須磨ニ於テハ二百九十四噸夫レカラ主汽罐並ニ附屬具及補助汽罐夫レガ秋津洲ニ於キマシテハ三百二噸須磨ニ於キマシテハ三百四十七噸秋津洲ノ方ハだぶるゑんでつどノモノガ四個デアリマシテ須磨ノ方ハしんぐるゑんでつどノモノガ八個這入ッテ居リマス夫レデ汽罐ノ重量ガ餘程多イ、夫レカラ此ノ罐水ノ重量之レガ秋津洲ニ於キマシテ九十一噸須磨ニ於キマシテ九十八噸夫レデ機關部ノ重量ガ秋津洲ニ於キマシテハ六百九十六噸須磨ノ方ガ七百三十九噸ニナル機關部ハ須磨ノ方ガ重ウゴザイマス、夫レカラ兵器ノ重量ガ秋津洲ニ於キマシテハ二百十四噸須磨ニ於キマシテハ百八十四噸夫レカラ石炭即チ定量石炭ノ重量ガ秋津洲ニ於テ三百噸須磨ニ於テ二百噸夫レデ實際ノ排水量ハ秋津洲ニ於キマシテハ三千二百十八噸須磨ニ於キマシテハ二千八百噸、夫レデ今此ノ各部ノ材料ノ重量ト排水量等トノ比例ヲ出シテ置キマシタガ併シ之レヲ今一々申上ゲタ處ガ御記憶ニモナリマスマイカラ先刻申シタ通リ別表ニ就テ御覽下サイ、

夫レカラ船ノ代價ガ隨分精シク統計ニ爲ッテ居ル之レガ船殼並ニ防禦甲板、雜作並ニ艦屬品、汽艇、端舟夫レカラ船ヲ造ルニハ矢張船殼並ニ進水ノ工事トカ試驗費トカ云フモノヲ其ノ內ニ入レナケレバナラヌ、夫レカラ機關部ニ於キマシテハ機關ト云フモノハ一ノ總稱ニ爲テ居ッテ汽機機械、汽罐並ニ附屬具、汽艇用機關夫レカラ機關ノ試驗等デ以テ機關部ト爲テ居リマス、夫レデ此ノ船體部並ニ機關部ト云フモノヲ拵ヘルニ方テ何レダケノ延職工ヲ使ッタカト云ヘバ秋津洲ニ於キマシテ九十九萬二千九百五十九人程使ッテ居ル、夫レカラ須磨ノ方ハ百四萬六千六百十七人ト云フモノヲ使ッテ居ル、夫レカラ其ノ職工ノ工費ト云フモノハ幾ラカト云フト秋津洲ハ三十三萬二百四十九圓須磨デ三十四萬千七百二十八圓材料費ハ幾ラカト云フト秋津洲ガ六十一萬六千八百二十六圓須磨デハ六十五萬三千六百十七圓詰リ船體機關ト云フモノヲ拵ヘルニ秋津洲ニ於テハ九十四萬七千七十五圓ト云フモノニナル須磨ノ方デハ九十九萬四千七百九十五圓ト云フモノニ爲テ居リマシテ大概似テ居リマスガ或ハ物價ノ騰貴デアリマシタカ或ハ材料ノ良イモ

ノナ使ッタカ須磨ノ方ガ僅ニ高イ、ソコデ今日ハ別表ニ種々船ノ重サヤ代價ヲ出シテ置キマシタガ隨分船ノ豫算ヲスルニハ極ク精密ナ處カラ造ルト云フ譯ニハ往キマセヌカラ斯ウ云フモノヲ澤山ニ統計ヲ致シテ置キマシタナラバ船ノ豫算抔ヲナサル時ニ幾分カノ助ケニナラウト思ヒマス、ソコデ一々之レヲ分カル樣ニ表ニ擧ケテ置キマシタ又今日高雄、愛宕アタリノ處ノ大畧ノ統計モ出シテ見マシタガ種々茲ニ統計上カラ取テ見マスルト云フト面白イ事モ隨分アルノデゴザイマス、丁度機械ノ强壓通風ノ馬力其ノ一馬力ニ對シテ何レダケノ職工ヲ使ッテ居ルカト云フコトヲ調ベテ見ルト六十人乃至五十人位夫レカラ又タ職工一人ニ對シ何レダケノ强壓馬力ニナルモノデアルカト云フニこんま零二ト云フ馬力ニナル夫レガ餘リ變ラヌ愛宕、須磨、秋津洲ニ於テ餘リ變リマセヌ、

夫レカラ又タ高雄、愛宕ノ如キハ今日世ノ中ニ知レテ居ル船ノ直段ト云フモノハ非常ニ高イ、夫レハ其ノ高イ理屈ガアルノデアリマス、之レモ一ト通リ古イ事ニ渉リマスケレドモ序ニ申シテ置キマセウ、

抑モ横須賀ノ造船所ガ作業ノ廳デアリマシタ時分ニハ其ノ内ノ諸賄ヒト云フモノヲ爲テ行カナケレバナラヌ即チ機械ヲ買フトカ或ハ建築ヲスルトカ役人ノ給料ヲ拂フトカ一切萬端ノ賄ヒヲセニヤナラヌ詰リ營業的デアル、ダカラ眞ノ船ノ直段ヨリ餘計ニ取ラレル、サウセニヤア造船所ハ立チ往カヌ、ソコデ高雄ノ如キハ表向キニシマスルト六十六萬五千四百九十八圓ト云フ製造費デアル併シナガラ今日夫レヲ實費デ調ベテ見マスルト云フト四十六萬五千何某ト云ッテモノニナル、愛宕ノ如キハ二十六萬二千四百九十一圓ト云フ表高ニナッテ居リマスガ其ノ實ヲ調ベルト十七萬二千百三十一圓ト云フモノニナル、夫レデ此ノ表高ト實際ト比較ヲ取テ見ルト愛宕ノ方デ九萬何某ト云フモノヲ餘計ニ取テ居ル、高雄ニ於テハ丁度二十萬圓計リ取ッテ居ル、之レハ製造所機械建築其ノ他種々ノモノニ使ッテ其ノ内僅カ四萬圓ソコイラト云フモノヲ純益トシテ國庫ヘ納メタモノデアリマス、夫レデ其ノ頃ノ船ノ直段ハ實際ノ船ノ直段ヨリ愛宕ニ於テハ五割二分高クナッテ居リ高雄ニ於テ四割三分ト云フモノガ高クナッテ居リマス、又タ高雄、愛宕ニ就テモ船體部機關部ノ直段等ニ就テ出シテ置キマシタカラ篤ト御覽ヲ願ヒタイ、又タ諸君ニ於テモ此ノ協會ニ對シテ何カ統計デモアリマシタナラバ充分ニ御話シアランコトヲ希望致シマス、之レハ海軍ニ從事シテ居ル人デ無クテモ亦タ海軍ニ居ル人デモ大層必要ナコトデゴザイマスカラ、夫レデ私モ船ノ直段ハ各國ヘ誂ヘタ船ノ直段モ知テ居リマス併シナガラ之レハ少シク申上ケラレヌ廉モアリマスカラ近頃ノ船ノ事ハ申シマセヌガ近日内國製造ノ明石ト云フ軍艦ト宮古ト云フ軍艦ガ落成ニナリマセウカラ必ズ其ノ代價等ヲ統計致シマシテ諸君ノ參考ニ供スル考ヘデアリマス、唯タ簡單ナル詰ラヌ話シデゴザイマシテ諸君ノ清聽ヲ煩ハシマシタ、

計畫要領	軍艦 秋津洲	軍艦 須磨
龍骨据付始メ	明治廿三年三月十五日	明治二十五年八月六日
竣工	明治廿七年三月卅一日	明治廿九年十二月二日
製造月數	四十八ヶ月半	五十二ヶ月
艦種	三等巡洋艦	三等巡洋艦
艦材ノ質	鋼	鋼
乘組人員	314名	296名
艦底	複底·露出	複底·露出
複底內防水區畫ノ數	11	11
複底上防水區畫ノ數	67	78
製造所 (船體機關共)	橫須賀造船部	橫須賀造船部
全長	97.850m	98.350m
垂線間ノ長	91.700m	93.500m
最大幅	13.144m	12.244m
肋面間ノ最大幅	13.100m	12.200m
深(龍骨ノ上面ヨリ上甲板中央側梁頂面マテ)	8.900m	7.700m
乾舷ノ高(水線ヨリ上甲板中央側梁頂面マテ)	3.600m	3.100m
吃水 前部	5.024m	4.229m
〃 後部	5.624m	5.029m
〃 平均	5.324m	4.629m
排水量	3,189 噸	2,700噸
水線下中央橫斷面積	58.718 sq. m.	48.070 sq. m.
水線面積	838.795 sq. m.	831.440 sq. m.
浮力ノ中心·水線下	2.126m	1.835m
〃 ·中央ヨリ後部ヘ	2.258m	1.702m
橫傾復原點·水線上	0.539m	0.957m
〃 ·浮力ノ中心上	2.665m	2.792m
〃 ·重心上	0.652m	0.637m
縱傾復原點·水線上	125.982m	150.872m
〃 ·浮力ノ中心上	128.108m	152.707m
〃 ·重心上	126.095m	150.552m
船體重心·水線ヨリ	0.113m 下ヘ	0.320m 上ヘ

計畫要領	軍艦 秋津洲	軍艦 須磨
水線面中心ノ中央ヨリ後部ヘ	3.982 m	3.137 m
水線面ニ於テ一吋ノ浮沈ニ對スル噸數	21.860 噸	21.666 噸
吃水ヲ前後合セ一吋變更スル「モーメント」	365 Foot-tons	359 Foot-tons
馬力ノ強壓通風全力	8,516	8,500
〃 ノ自然通風全力	5,272	5,000
速力ノ強壓通風全力	19 海里	20 海里
〃 ノ自然通風全力	17 海里	17 海里
石炭ノ定量	300 噸	200 噸
〃 ノ庫量	550 噸	600 噸
揚彈路ノ厚及質 （前後共）	50 m.m. 鋼	
司令塔ノ厚及質	50 m.m. 鋼	50 m.m. 鋼
防禦甲板ノ材質	鋼	鋼
〃 中央平坦部ノ厚	38 m.m.	19 m.m.
〃 傾斜部ノ厚	76 m.m.	51 m.m.
〃 前後部ノ厚	38 m.m.	19 m.m.
汽艇 カッタル	9.140 m 一隻	8.500 m 一隻
端舟 ピンネス	9.140 m 一隻	9.140 一隻
〃 カッタル	8.530 二隻	8.530 二隻
〃 ギッグ	8.220 二隻	8.220 一隻
〃 ガッレー		8.220 一隻
〃 ディンギー	4.260 一隻	4.260 一隻
駛船汽機製式	横置三回膨脹聯成	縱置三回膨脹聯成
〃 數	二個	二個
各汽機汽筩ノ數	三個	三個
汽筩ノ徑ノ高壓	826 m.m.	820 m.m.
〃 ノ中壓	1,206 m.m.	1,240 m.m.
〃 ノ低壓	1,924 m.m.	1,900 m.m.
衝程	890 m.m.	720 m.m.
回轉數ノ強壓通風全力	130	170
〃 ノ自然通風全力	110	145
主復水器ノ種類	表面冷凝	表面冷凝

計畫要領	軍艦 秋津洲	軍艦 須磨
主復水器・數 各汽機ニ付	一個	一個
〃・總冷汽面 各個ニ付	575.226 sq. m.	433.920 sq. m.
駛船螺旋・材質	滿俺青銅	滿俺青銅
〃・數	二個	二個
〃・翅數 各個ニ付	三枚	三枚
〃・直徑	4.^{m}100	3.^{m}750
〃・螺距	5.^{m}335	4.^{m}580
主汽罐・種類・材質	兩端焚火・鋼	低圓罐・鋼
〃・數	四個	八個
〃・汽壓	10.^{kil}5	10.^{kil}5
〃・胴直徑	3.^{m}902	3,^{m}060
〃・胴長	5.^{m}600	4.^{m}934
〃・火爐・種類	フックス・コルリユゲーテッド	プアュヴス・リップド
〃・〃數 各罐ニ付	六個	三個
〃・〃內徑	975 m.m.	1,020 m.m.
〃・〃長	2.^{m}295	1,943 m.m.
〃・焔管・材質	黃銅	黃銅
〃・〃直徑	70 m.m.	63.$^{m.m.}$5
〃・支柱管・材質	鋼	鋼
〃・〃・直徑	70 m.m.	63.$^{m.m.}$5
〃・受熱面積 各罐ニ付	349.07 sq. m.	169.78 sq. m.
〃・火床面積 各罐ニ付	11.34 sq. m.	5.16 sq. m.
兵裝		
四拾口徑六吋アームストロング速射砲	四門	二門
四拾口徑四.七吋アームストロング速射砲	六門	六門
四拾七密重ホッチキス速射砲	八門	十門
四拾七密輕ホッチキス速射砲	一門	二門
八密五連發ノーデンフェルト機砲	四門	四門
水雷發射管	四門	二門
探海電燈	四基	三基

	軍艦 秋津州		軍艦 須磨	
船殼重量	1,197	tons	1,065	tons
雜作重量	232	„	249	„
齊備品（乘組人員並所持品．淡水．水罐．糧食並其風袋．倉庫品．檣圓材並索具．錨．錨鎖並屬具．端舟．汽艇（罐水ヲ除ク）ノ諸重量）	223	„	218	„
防禦甲板重量	326	„	139	„
司令塔並揚彈路裝甲ノ重量	30	„	6	„
船體部重量	2,008	tons	1,677	tons
駛船汽機．補助機械並豫備具ノ重量	303	„	294	„
主汽罐並附屬具及補助汽罐ノ重量	302	„	347	„
主汽罐並補助汽罐水ノ重量	91	„	98	„
機關部重量	696	tons	739	tons
兵器重量	214	„	184	„
定量石炭ノ重量	300	„	200	„
實際ノ排水量	3,218	tons	2,800	tons
船體部材料ノ重量（船體部重量ヨリ乘組人員並所持品．淡水．糧食並其風袋．倉庫品ノ諸重量ヲ減シタルモノ）	1,876	tons	1,544	tons
機關部材料ノ重量（機關部重量ヨリ汽罐水ノ重量ヲ減シタルモノ）	605	tons	641	tons
馬力　强壓通風全力	8,516		8,500	
馬力　自然通風全力	5,272		5,000	

	軍艦 秋津洲		軍艦 須磨	
船殼重量 / 排水量	0.3720		0.3804	
雜作重量 / 排水量	0.0721		0.0889	
船殼雜作重量 / 排水量	0.4441		0.4693	
船體部材料重量 / 排水量	0.5830		0.5514	
一强壓馬力ニ對シ汽機機械豫備具ノ重量	35.6 kil	78.5 lbs	34.6 kil	76.3 lbs
一强壓馬力ニ對シ汽罐並罐水ノ重量	46.1 kil	101.6 lbs	52.4 kil	115.5 lbs
一强壓馬力ニ對シ機關部ノ重量	81.7 kil	180.1 lbs	86.9 kil	191.6 lbs
一自然馬力ニ對シ汽機機械豫備具ノ重量	57.5 kil	126,8 lbs	58.8 kil	129.6 lbs
一自然馬力ニ對シ汽罐並罐水重量	74,5 kil	164.2 lbs	89.0 kil	196.2 lbs
一自然馬力ニ對シ機關部ノ重量	132.0 kil	291.0 lbs	147.8 kil	325.8 lbs
排水量一噸ニ對シ兵器ノ重量	66.5 kil		65.7 kil	
排水量一噸ニ對シ定量石炭ノ重量	93.2 kil		71.4 kil	
一强壓馬力ニ對シ定量石炭ノ重量	35.2 kil		23.5 kil	
一自然馬力ニ對シ定量石炭ノ重量	56.9 kil		40.0 kil	
排水量一噸ニ對シ船體部ノ重量	$\frac{2,008}{3,218}$=624.0 kil		$\frac{1,677}{2,800}$=598.9 kil	
排水量一噸ニ對シ機關部ノ重量	$\frac{696}{3,218}$=216.3 kil		$\frac{739}{2,800}$=263.9 kil	
排水量一噸ニ對シ船體部, 機關部, 兵器, 石炭ノ各重量	624.0(船), 216.3(機), 66.5(兵), 93.2(石).		598.9(船), 263.9(機), 65.7(兵), 71.4(石).	

講演

軍艦秋津洲 軍艦須磨 製造工數並製造費

（各欄上段：軍艦秋津洲、下段（朱）：軍艦須磨）

	工數	工費	材料費	合計
	人	円	円	円
船殼並防禦甲板	339,505.308 285,769.271	115,867.327 97,138.284	203,397.039 181,322.942	319,264.366 278,461.226
雜作並艦屬品	216,711.126 238,541.829	74,094,104 80,262,898	98,367.104 130,066,697	172,461.208 210,329,595
汽艇	1,701.850 1,829.650	601.115 689.725	526.887 417.599	1,128.002 1,107.324
端舟	5,097.105 4,271.050	1,899.596 1,592.195	1,833.931 1,637.620	3,733.527 3,229.815
船臺並進水工事	8,466.399 14,467.649	3,315.036 5,577.553	2,529.737 11,428.965	5,844.773 17,006.518
試驗	2,939.700 3,548.318	1,025.174 1,322,947	149.184 168.854	1,174.358 1,491.801
船體部合計	574,421.488 548,427.767	196,802.352 186,583.602	306,803.882 325,042.677	503,606.234 511,626.279
汽機機械	238,929.494 253,176.768	79,006.848 83,903.794	189,357.323 183,615.520	268,364.171 267,519.314
汽罐並附屬具	168,327.461 223,232.829	50,857.494 67,321.950	109,701.707 135,070.709	160,559.201 202,392.659
汽艇用機關	4,375.000 3,151.400	1,340.453 909.274	1,594.038 843.590	2,934.491 1,752.864
試驗	6,906.071 8,648.552	2,241.928 3,009.899	9,369.565 8,494.965	11,611.493 11,504.864
機關部合計	418,538.026 498,189.559	133,446.723 155,144.917	310,022.633 328,024.784	443,469.356 483,169.701
船體部並機關部	992,959.514 1,046,617.326	330,249.075 341,728.516	616,826.515 653,067.461	947,075.590 994,795.980
備品（需品中ノ）	8,873.350 9,363.300	3,581.948 3,255.197	37,824.249 28,878.515	41,406.197 32,133.712
雜費	273.850 394.300	124.654 154.904	2,165.214 2,001.253	2,289.866 2,156.157
總計	1,002,106.714 1,056,374.626	333,955.675 345,138.617	656,815.978 683,947.229	990,771.653 1,029,085.846

	軍艦 秋津洲	軍艦 須磨
船體部職工一人ノ平均工費	$\frac{196,802.352円}{574,421.488人} = 0.343円$	$\frac{186,583.602円}{548,427.767人} = 0.340円$
機關部職工一人ノ平均工費	$\frac{133,446.723円}{418,538.026人} = 0.319円$	$\frac{155,144.917円}{498,189.559人} = 0.311円$
船體部機關部職工一人ノ平均工費	$\frac{330,249.075円}{992,959.514人} = 0.333円$	$\frac{341,728.516円}{1,046,617.326人} = 0.327円$
全職工一人ノ平均工費	$\frac{333,955.675円}{1,002,106.714人} = 0.333円$	$\frac{345,138.617円}{1,056,374.626人} = 0.357円$
船體部材料ノ重量一噸ニ對スル工數	$\frac{574,421.488人}{1,876噸} = 307人$	$\frac{548,427.767人}{1,544噸} = 356人$

	軍艦 秋津洲	軍艦 須磨
機關部材料ノ重量一噸ニ對スル工數	$\frac{418,538.026^{\text{人}}}{605_{T}}=692^{\text{人}}$	$\frac{498,189.559^{\text{人}}}{641_{T}}=778^{\text{人}}$
一強壓馬力ニ對スル機關部工數	$\frac{418,538.026^{\text{人}}}{8,516_{HP}}=50^{\text{人}}$	$\frac{498,189.559^{\text{人}}}{8,500_{HP}}=59^{\text{人}}$
一自然馬力ニ對スル機關部工數	$\frac{418,538.026^{\text{人}}}{5,272_{HP}}=80^{\text{人}}$	$\frac{498,189{\cdot}559^{\text{人}}}{5,000_{HP}}=100^{\text{人}}$
船體部機關部兩材料ノ重量一噸ニ對スル工數	$\frac{992,959.514^{\text{人}}}{2,481_{T}}=401^{\text{人}}$	$\frac{1,046,617.326^{\text{人}}}{2,185_{T}}=480^{\text{人}}$
排水量一噸ニ對スル船體部機關部工數	$\frac{992,959.514^{\text{人}}}{3,218_{T}}=309^{\text{人}}$	$\frac{1.046,617.326^{\text{人}}}{2,800_{T}}=374^{\text{人}}$
職工一人ニ對スル船體部材料ノ重量	$\frac{1^{T}}{307_{\text{人}}}=3.257^{kil}$	$\frac{1^{T}}{356_{\text{人}}}=2.809^{kil}$
職工一人ニ對スル機關部材料ノ重量	$\frac{1^{T}}{692_{\text{人}}}=1.445^{kil}$	$\frac{1^{T}}{778_{\text{人}}}=1.285^{kil}$
職工一人ニ對スル強壓馬力	$\frac{1^{HP}}{50_{\text{人}}}=0.0200^{HP}$	$\frac{1^{HP}}{59_{\text{人}}}=0.0169^{HP}$
職工一人ニ對スル自然馬力	$\frac{1^{HP}}{80_{\text{人}}}=0.0125^{HP}$	$\frac{1^{HP}}{100_{\text{人}}}=0.0100^{HP}$
職工一人ニ對スル船體部機關部兩材料ノ重量	$\frac{1^{T}}{401_{\text{人}}}=2.494^{kil}$	$\frac{1^{T}}{480_{\text{人}}}=2.083^{kil}$
職工一人ニ對スル排水量	$\frac{1^{T}}{309_{\text{人}}}=3.236^{kil}$	$\frac{1^{T}}{374_{\text{人}}}=2.674^{kil}$
船體部材料ノ重量一噸ニ對スル工費	$\frac{196,802.352^{\text{円}}}{1,876_{T}}=104.905^{\text{円}}$	$\frac{186,583.602^{\text{円}}}{1,544_{T}}=120.844^{\text{円}}$
機關部材料ノ重量一噸ニ對スル工費	$\frac{133,446.723^{\text{円}}}{605_{T}}=220.573^{\text{円}}$	$\frac{155,144.917^{\text{円}}}{641}=242.036^{\text{円}}$
一強壓馬力ニ對スル機關部工費	$\frac{133,446.723^{\text{円}}}{8,516_{HP}}=15.670^{\text{円}}$	$\frac{155,144.917^{\text{円}}}{8.500_{HP}}=18.252^{\text{円}}$
一自然馬力ニ對スル機關部工費	$\frac{133,446.723^{\text{円}}}{5,272_{HP}}=25.312^{\text{円}}$	$\frac{155,144.917^{\text{円}}}{5,000_{HP}}=31.029^{\text{円}}$
船體部機關部兩材料ノ重量一噸ニ對スル工費	$\frac{330,249.075^{\text{円}}}{2,481_{T}}=133.111^{\text{円}}$	$\frac{341,728.519^{\text{円}}}{2,185_{T}}=156.397^{\text{円}}$
排水量一噸ニ對スル船體部機關部工費	$\frac{330,249.075^{\text{円}}}{3,218_{T}}=102.626^{\text{円}}$	$\frac{341,728.519^{\text{円}}}{2,800_{T}}=122.046^{\text{円}}$
船體部材料ノ重量一噸ニ對スル材料費	$\frac{306,803{\cdot}882^{\text{円}}}{1,876_{T}}=163.542^{\text{円}}$	$\frac{325\ 042.677^{\text{円}}}{1,544_{T}}=210\ 520^{\text{円}}$

	軍艦 秋津洲	軍艦 須磨
機關部材料ノ重量一噸ニ對スル材料費	$\frac{310{,}022.633}{605_{T}}=512.434$	$\frac{328{,}024.784}{641_{T}}=511.739$
一强壓馬力ニ對スル機關部材料費	$\frac{310{,}022.633}{8{,}516_{HP}}=36.405$	$\frac{328{,}024.784}{8{,}500_{HP}}=38.591$
一自然馬力ニ對スル機關部材料費	$\frac{310{,}022.633}{5{,}272_{HP}}=58.806$	$\frac{328{,}024.784}{5{,}000_{HP}}=65.605$
船體部機關部兩材料ノ重量一噸ニ對スル材料費	$\frac{616{,}826.515}{2{,}481_{T}}=248.620$	$\frac{653{,}067.461}{2{,}185_{T}}=298.887$
排水量一噸ニ對スル船體部機關部材料費	$\frac{616{,}826.515}{3{,}218_{T}}=191.680$	$\frac{653{,}067.461}{2{,}800_{T}}=233.238$
船體部材料ノ重量一噸ニ對スル工費並材料費	$\frac{503{,}606.234}{1{,}876_{T}}=268.447$	$\frac{511{,}626.279}{1{,}544_{T}}=331.364$
機關部材料ノ重量一噸ニ對スル工費並材料費	$\frac{443{,}469.356}{605_{T}}=733.007$	$\frac{483{,}169.701}{641_{T}}=753.775$
一强壓馬力ニ對スル機關部工費並材料費	$\frac{443{,}469.356}{8{,}516_{HP}}=52.075$	$\frac{483{,}169.701}{8{,}500_{HP}}=56.843$
一自然馬力ニ對スル機關部工費並材料費	$\frac{443{,}469.356}{5{,}272_{HP}}=84.118$	$\frac{483{,}169.701}{5{,}000_{HP}}=96.634$
船體部機關部兩材料ノ重量一噸ニ對スル工費並材料費	$\frac{947{,}075.590}{2{,}481_{T}}=381.731$	$\frac{994\ 795.980}{2{,}185_{T}}=455.284$
排水量一噸ニ對スル船體部機關部工費並材料費	$\frac{947{,}075.590}{3{,}218_{T}}=294.306$	$\frac{994{,}795.980}{2{,}800_{T}}=355.284$
船體部製造費ト工費ト材料費トノ割合	100製 39.1工 60.9材	100製 36.5工 63.5材
機關部製造費ト工費ト材料費トノ割合	100製 30.1工 69.9材	100製 32.1工 67.9材
船體部機關部製造費ト工費ト材料費トノ割合	100製 34.9工 65.1材	100製 34.4工 65.6材

軍艦愛宕 軍艦高雄 製造工數並製造費

	工數	工費	材料費	合計
船體部	134,872.450 人 310,417.000	42,141.453 円 97,637.423	62,259.088 円 164,455.147	104.400.540 円 262,092.570
機關部	52,562.050 122,637.350	16,685.295 39,327.532	31,261.662 96,992.752	47,946.957 136,320.284
船體部並機關部	187,434.500 433,054.350	58,826.747 136,954.955	93,520.750 261,447.899	152,347.497 398,412.854
備品 （需品中ノ）				19,783.805 66,593.730
總計				172,131.302 465,006.584
船體部並機關部 （收入）				220,610.129 556,887.809
總計 （收入）				262,491.934 665,498.148

	軍艦 愛宕	軍艦 高雄
船體部職工一人ノ平均工費	$\frac{42,141.452 \text{円}}{134,872.450 \text{人}} = 0.312 \text{円}$	$\frac{97,637.423 \text{円}}{310.417.000 \text{人}} = 0.315 \text{円}$
機關部職工一人ノ平均工費	$\frac{16,685.295 \text{円}}{52,562.050 \text{人}} = 0.317 \text{円}$	$\frac{39,327.532 \text{円}}{122,637.350 \text{人}} = 0.321 \text{円}$
船體部機關部職工一人ノ平均工費	$\frac{58,826.747 \text{円}}{187,434.500 \text{人}} = 0.314 \text{円}$	$\frac{136,964.955 \text{円}}{433,054.350 \text{人}} = 0.316 \text{円}$
一強壓馬力ニ對スル機關部工數	$\frac{52,562.050 \text{人}}{963_{HP}} = 55 \text{人}$	$\frac{122,637.350 \text{人}}{2,332_{HP}} = 53 \text{人}$
排水量一噸ニ對スル船體部機關部工數	$\frac{187,434.500 \text{人}}{622_{T}} = 302 \text{人}$	$\frac{433,054.350 \text{人}}{1,778_{T}} = 244 \text{人}$
職工一人ニ對スル強壓馬力	$\frac{1^{HP}}{55_{\text{人}}} = 0.0182^{HP}$	$\frac{1^{HP}}{53_{\text{人}}} = 0.0189^{HP}$
職工一人ニ對スル排水量	$\frac{1^{T}}{302_{\text{人}}} = 3.311^{kil}$	$\frac{1^{T}}{244_{\text{人}}} = 4.098^{kil}$
一強壓馬力ニ對スル機關部工費	$\frac{16,685.295 \text{円}}{963_{HP}} = 17.326 \text{円}$	$\frac{39,327.532 \text{円}}{2,332_{HP}} = 16.864 \text{円}$
排水量一噸ニ對スル船體部機關部工費	$\frac{58,826.747 \text{円}}{622_{T}} = 94.577 \text{円}$	$\frac{136,964.955 \text{円}}{1,778_{T}} = 77.033 \text{円}$
一強壓馬力ニ對スル機關部材料費	$\frac{31,261.662 \text{円}}{963_{HP}} = 32.463 \text{円}$	$\frac{96,992.752 \text{円}}{2,332_{HP}} = 41.592 \text{円}$
排水量一噸ニ對スル船體部機關部材料費	$\frac{93,520.750 \text{円}}{622_{T}} = 150.355 \text{円}$	$\frac{261,447.899 \text{円}}{1,778_{T}} = 147.046 \text{円}$

	軍艦 愛宕	軍艦 高雄
一强壓馬力ニ對スル機關部工費並材料費	$\frac{47,946.957^{円}}{963_{HP}}=49.789^{円}$	$\frac{136,320.284^{円}}{2,332_{HP}}=58.456^{円}$
排水量一噸ニ對スル船體部機關部工費並材料費	$\frac{152,347.497^{円}}{622_{T}}=244.932^{円}$	$\frac{398,412.854^{円}}{1,778_{T}}=224.090^{円}$
船體部製造費ト工費ト材料費トノ割合	$100_{製}$ $40.4_{工}$ $59.6_{材}$	$100_{製}$ $37.3_{工}$ $62.7_{材}$
機關部製造費ト工費ト材料費トノ割合	$100_{製}$ $34.8_{工}$ $65.2_{材}$	$100_{製}$ $28.8_{工}$ $71.2_{材}$
船體部機關部製造費ト工費ト材料費トノ割合	$100_{製}$ $38.6_{工}$ $61.4_{材}$	$100_{製}$ $34.4_{工}$ $65.6_{材}$
龍骨据付始メ	明治十九年七月十七日	明治十九年十月三十日
竣工	明治二十二年三月二日	明治廿二年十一月十六日
製造月數	三十二ヶ月	三十七ヶ月
船體機關製造費收入費ト實費トノ差	$68,262.632^{円}$ 44.8% of 實費	$158,474.955^{円}$ 39.8% of 實費
總製造費收入費ト實費トノ差	$90,360.632^{円}$ 52.5% of 實費	$200,491.564^{円}$ 43.1% of 實費

明治三十一年十二月廿四日印刷
明治三十一年十二月廿八日發行

發行所　東京市京橋區山城町十五番地
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