Dec. 25, 1951 P. S. DICKEY 2,580,345

VAPOR GENERATING AND CONTROL SYSTEM

Original Filed July 24, 1940 5 Sheets-Sheet 1

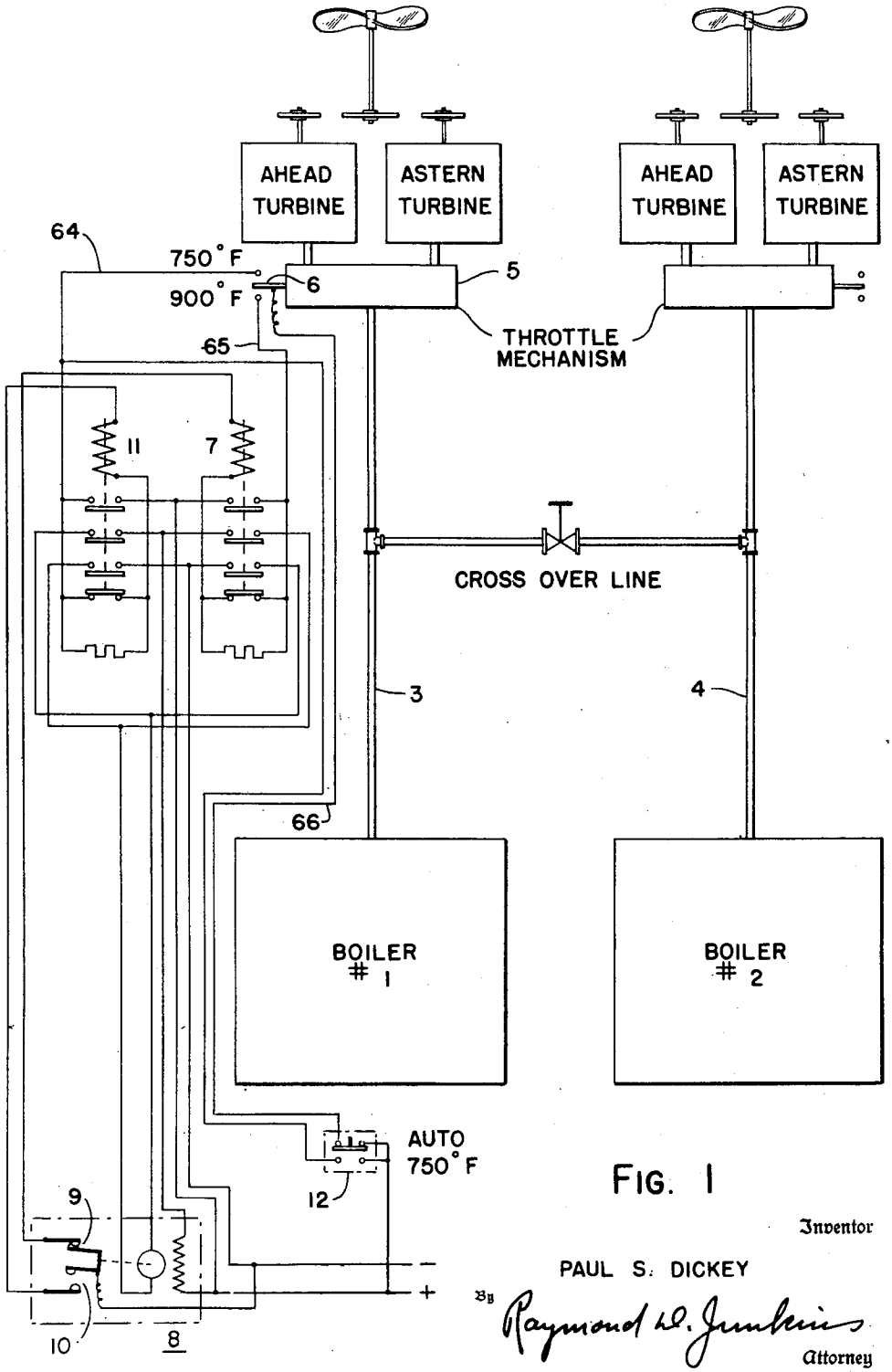


FIG. 1

Inventor

PAUL S. DICKEY

By Raymond W. Jenkins

Attorney

Dec. 25, 1951 P. S. DICKEY 2,580,345

VAPOR GENERATING AND CONTROL SYSTEM

Original Filed July 24, 1940 5 Sheets-Sheet 2

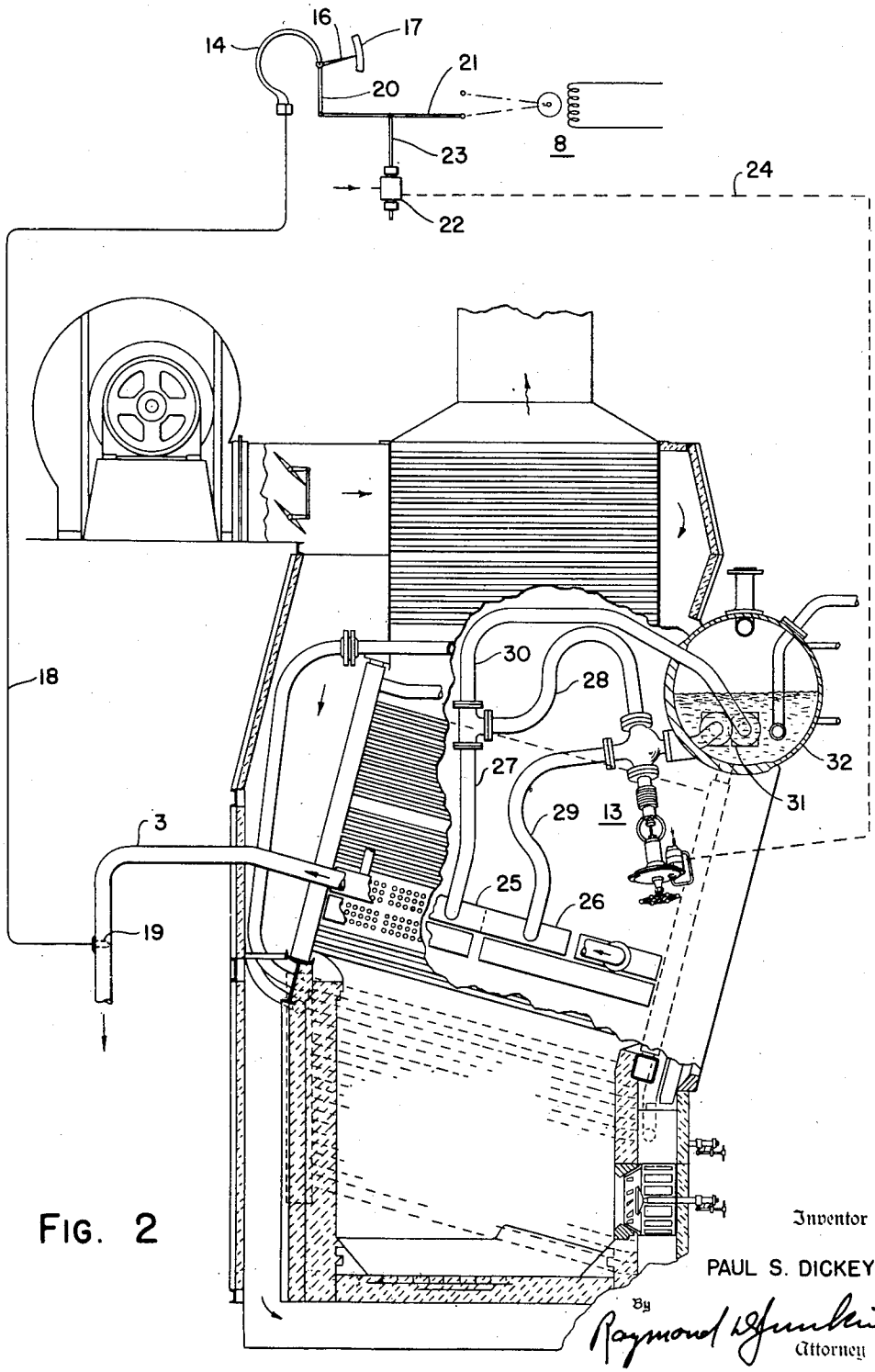


FIG. 2

Inventor

PAUL S. DICKEY

By Raymond W. Franklin

Attorney

VAPOR GENERATING AND CONTROL SYSTEM

Original Filed July 24, 1940 5 Sheets-Sheet 3

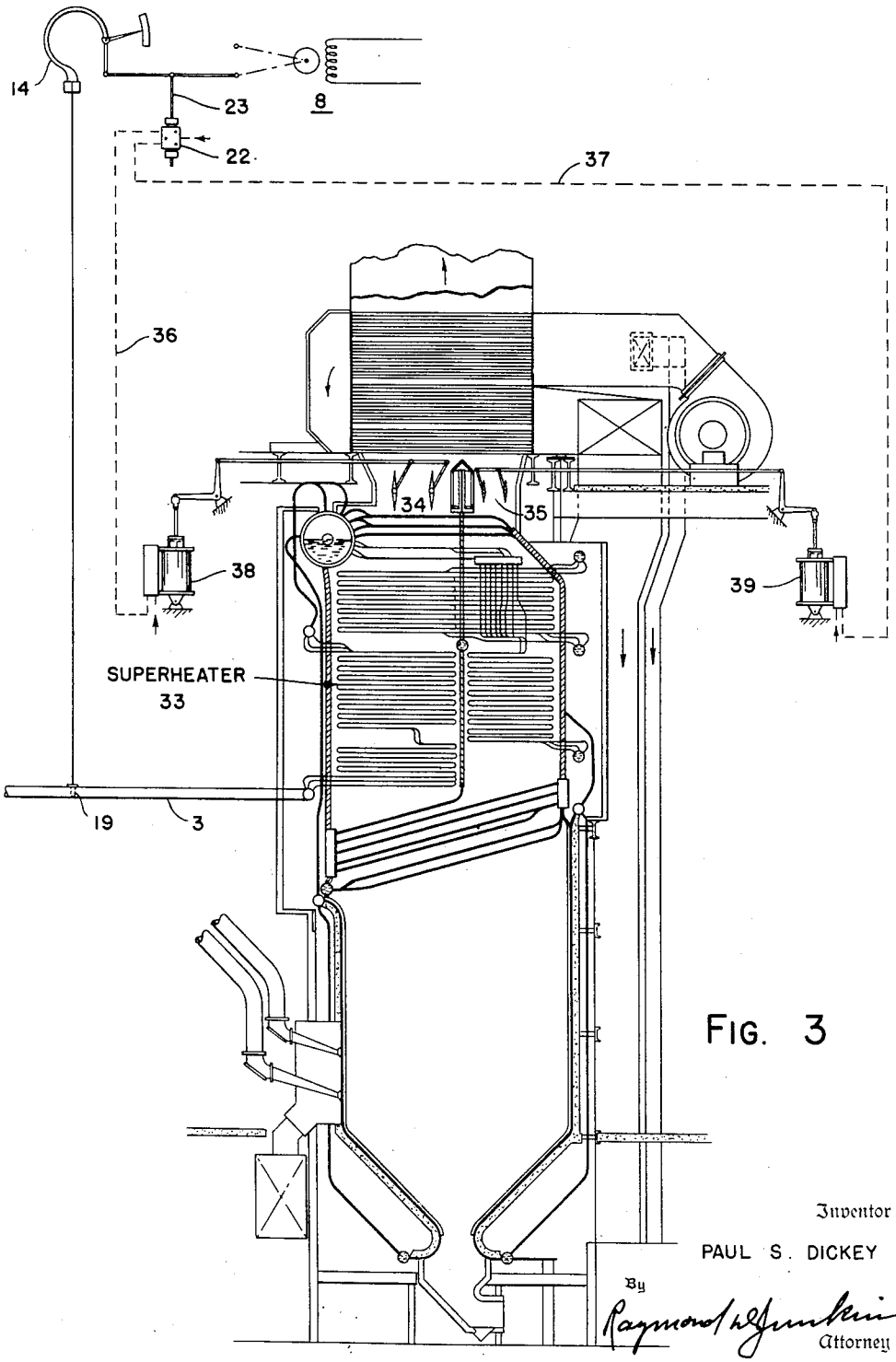


FIG. 3

Inventor
PAUL S. DICKEY
By
Raymond W. Jenkins
Attorney

VAPOR GENERATING AND CONTROL SYSTEM

Original Filed July 24, 1940 5 Sheets-Sheet 4

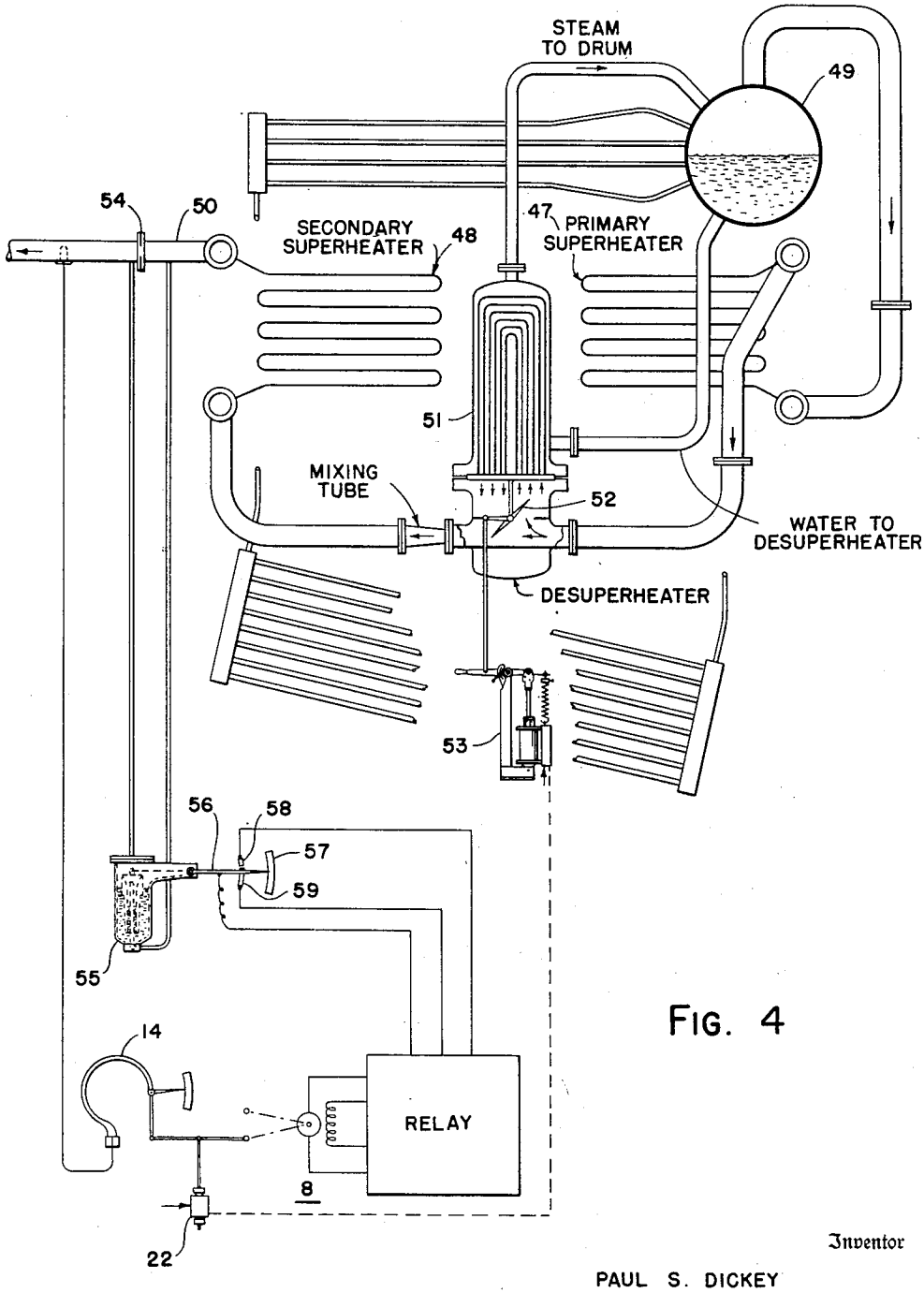


FIG. 4

Inventor

PAUL S. DICKEY

By

Raymond W. Jumbeis

Attorney

Dec. 25, 1951 P. S. DICKEY 2,580,345

VAPOR GENERATING AND CONTROL SYSTEM

Original Filed July 24, 1940 5 Sheets-Sheet 5

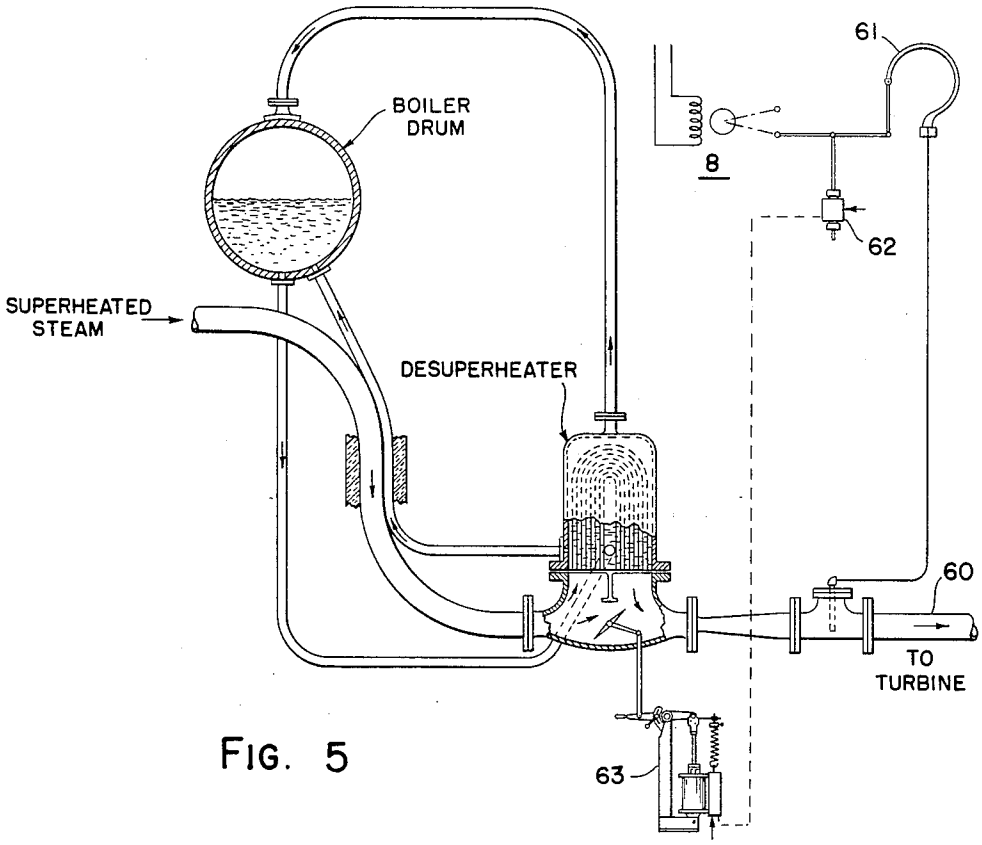


FIG. 5

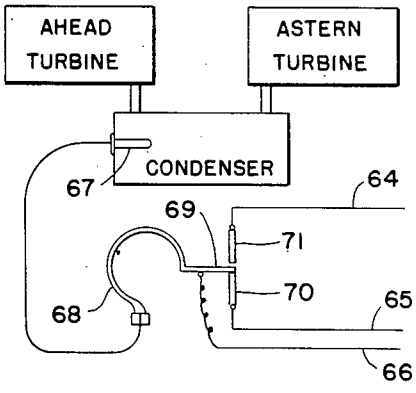


FIG. 6

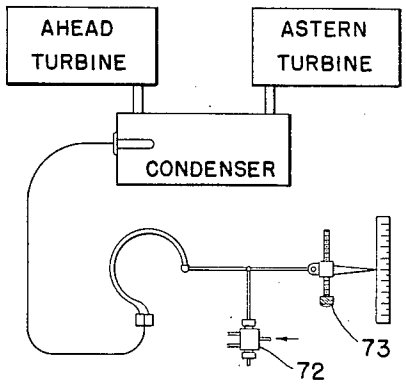


FIG. 7

Inventor

PAUL S. DICKEY

By Raymond W. Junkin

Attorney

Patented Dec. 25, 1951

2,580,345

UNITED STATES PATENT OFFICE

2,580,345

VAPOR GENERATING AND CONTROL SYSTEM

Paul S. Dickey, East Cleveland, Ohio, assignor to Bailey Meter Company, a corporation of Delaware

Original application July 24, 1940, Serial No. 347,192. Divided and this application November 23, 1945, Serial No. 630,489

10 Claims. (Cl. 60—102)

1

This invention relates to method and means for operating and controlling the operation of power plants; particularly power plants including vapor generators and vapor utilizers, such for example as steam generating boilers and steam utilizing turbines.

One particular type of power plant to which the invention is directed is for marine use, although the general features of the invention are equally adapted to stationary power plants.

In marine service it is known to equip a ship with two propellers each gear-connected to an ahead and an astern turbine; each pair of turbines exhausting to one or more surface condensers. The ahead turbine normally operating at relatively uniform and most efficient load may utilize high temperature steam, for example in a range of 900° F., and will extract sufficient work from the steam so that the exhaust to the condenser will be at a safe low temperature for which the condenser is designed. The astern turbine, normally idling backwards, is given no opportunity to warm up when a signal for backing operation is had. Furthermore, the design of the infrequently operated astern turbine is one which will not extract from the steam as great an amount of work as will the normally loaded ahead turbine. Thus the steam exhausting from the astern turbine to the condenser will be at a relatively higher percentage of the initial temperature than that steam exhausting from the ahead turbine. The surface condenser, normally designed for the steam exhausted from the ahead turbine, is in danger of being damaged by the relatively higher temperature steam exhausted from the astern turbine. It is therefore usually desirable to design and operate the astern turbine at a different temperature standard than the ahead turbine.

In the docking of all vessels and in the maneuvering of such high speed vessels as destroyers and the like it is not uncommon to have an immediate change in load of 80% to 90% of maximum output and/or to have a sudden and immediate reversal of direction or alternate use of the ahead and the astern turbines. The danger to the condenser of such shift in operation is apparent.

It is a principal feature of my invention to provide a method and apparatus for properly controlling the total temperature of the steam supplied to the ahead and to the astern turbines from the vapor generator. It is a further object to provide a system for automatically varying the temperature standard to which the steam temperature control system works, so that the proper

2

temperature standard may be maintained for the ahead turbine and for the astern turbine, or in fact for any combination of the two or range in operation of either.

The present invention, while directed particularly to a steam temperature control at different standards for marine service, is nevertheless adapted to stationary boiler service. Stationary boilers in central stations, for example, are often so designed that they feed a single turbine with steam at relatively high temperatures and pressures, for example, 950° F. and 1250 lb. per square inch gauge. It is also possible to use the same vapor generator to supply steam alternatively to a second turbine at relatively lower temperatures and pressures, for example a temperature of 750° F. and pressure of 600 lb. per square inch gage. If, for example, the high pressure-temperature turbine loses its load suddenly it becomes immediately desirable and perhaps necessary to switch the output of the vapor generator to the lower pressure-temperature turbine, and this at a new standard of both temperature and pressure for the control of the vapor generator.

It is an object of my invention to provide a system which will accomplish this change in standard in both temperature and in pressure for control purposes in stationary plants.

Further objects will become apparent from a study of the drawing and of the description in relation to the claims appended thereto.

In the drawing:

Fig. 1 is a diagrammatic illustration of a power plant for a ship including preferred arrangements of turbines and vapor generators and a partial disclosure of the control system in connection therewith.

Fig. 2 is a sectional elevation of a marine type vapor generator, such for example as might be one of the boilers of Fig. 1, and to which the invention has been applied.

Fig. 3 is a sectional elevation of a high head open pass stationary type of vapor generator to which the invention has been applied.

Fig. 4 is a somewhat diagrammatic sectional elevation of a further type of boiler arrangement to which the control has been adapted.

Fig. 5 is a diagrammatic illustration of the control adapted to a desuperheater.

Figs. 6 and 7 are diagrammatic illustrations of a portion of a marine power plant showing further modifications of the invention.

In the drawings like numerals have been applied to identical parts.

In Fig. 1 I illustrate two boilers, each directly

connected by means of a conduit to the throttle mechanism of an ahead and of an astern turbine for driving a ship's propeller. In other words, the ship has two propellers and each has connected thereto (through the necessary gears) an ahead turbine and an astern turbine. When the ship is moving forward, both ahead turbines are operating and the two astern turbines are being driven idling backwards. There is a crossover line shown interconnecting the steam conduits at 3 and 4. Inasmuch as the two power systems are duplicate I have illustrated and will describe certain control arrangements only in connection with boiler #1 and its related turbines. It is to be understood that equivalent control arrangements are in service adapted to boiler #2 and its related turbines.

The particular example illustrated in Fig. 1, and now to be described, utilizes steam from the boiler 1 at 900° F. for the ahead turbine, and at 750° F. for the astern turbine. Inasmuch as neither the astern turbine nor the condenser to which both of the turbines exhaust is adapted to withstand the application of relatively high temperature steam it becomes advisable and, in fact, necessary for safety, to change the temperature of the steam supplied to the throttle mechanism through the conduit 3 when operation is switched from the ahead turbine to the astern turbine, and vice versa. Such switching operation is accomplished by the throttle mechanism 5, which through its position and/or movement automatically changes the temperature standard to which the boiler 1 is operating.

For example, the arrangement shown in Fig. 1 provides a switch 6 connected to the throttle mechanism 5 in such manner that if the throttle is moved to admit steam to the ahead turbine, the contact arm 6 closes circuit with the contact marked 900° F., energizing the relay 7, which in turn causes a rotation of the motor 8 to adjust the temperature standard of the control mechanism for boiler #1 to a standard of 900° F. The motor 8 continues to rotate and move the standard adjusting mechanism until limited in its travel by the limit switch shown. As soon as the necessary movement of the temperature standard adjustment has been accomplished through predetermined motion of the motor 8, the limit switch 9 will break the holding circuit of the relay 7, stopping further rotation of the motor 8. Simultaneously with opening the limit switch 9, the limit switch 10 has become closed, so that an energization of the reversing relay 11 may immediately occur for rotation of the motor 8 in opposite direction to shift the standard to 750° F. if called for by a movement of the throttle mechanism 5 from the ahead turbine to the astern turbine and corresponding movement of the throttle contact arm 6 from the contact marked 900° F. to that which is marked 750° F.

It will thus be seen that whenever the drive of the propeller of unit #1, for example, is changed from the ahead turbine to the astern turbine, or vice versa, the motor 8 at the control location for boiler #1 is moved to shift the temperature standard adjustment to either 900° F. or 750° F. temperature standard as required for operation of the one turbine or the other turbine respectively.

It will be appreciated, of course, that the temperature standard may be other than 750° or 900° F., and the same arrangement is utilized to change from one to the other standard as may be required for proper turbine operation.

It has been found that when maneuvering or docking it may be desirable to rapidly switch from ahead to astern turbine operation, or in fact to have the ahead turbine of unit #1 operating, and the astern turbine of unit #2, or to swing rapidly from one combination to another. Inasmuch as such major changes in type of operation will be known sometime in advance and may be advised from the bridge to the fireroom, I have provided by the push button station 12 a means for readily taking the temperature control electrical system off from automatic and placing it on to a continuous 750° F. temperature standard basis. In other words, both the ahead and the astern turbines, or any combination of them, will be operated at 750° F. during such rapidly changing, maneuvering or docking operation. The push button station 12 assumes the last position placed in and as illustrated in Fig. 1 connects the system for complete automatic operation of shifting from one temperature standard to another. If the button is depressed into the alternate position from that shown, then the 750° contact gap on the throttle mechanism 5 is bridged and the 900° contact may not be close circuited irrespective of any demand through the agency of the throttle mechanism for such closure by the contact arm 6.

Thus so long as the push button station 12 breaks the automatic circuit and closes the 750° F. circuit, the temperature standard under which the boiler #1 is operating will be at 750° irrespective as to whether the ahead or the astern turbine is operating. Of course it will be appreciated that similar provisions are provided in connection with unit #2.

Referring now to Fig. 2, I illustrate the control system of a representative marine type of vapor generator such as boiler #1 of Fig. 1. Herein I show a control of a 3-way valve 13 positioned pneumatically in accordance with the dictates of a temperature sensitive system and of the motor 8. The Bourdon tube 14, forming part of a system sensitive to the total temperature of the steam leaving the boiler and passing through the conduit 3, indicates by means of the pointer 16 moving relative to the index 17 the value of the total steam temperature. The Bourdon tube 14 forms a part of a trapped gas filled temperature sensitive system and is connected by a capillary tubing 18 to a bulb 19 positioned in the superheated steam outflow line 3.

Freely suspended from the movable end of the Bourdon tube 14 is a link 20 carrying at its free end one end of a floating link 21, the other end of which is positioned by the motor 8 to one or the other of two extremes of travel representing respectively a 750° temperature standard and a 900° temperature standard. Suspended intermediate the ends of the floating beam 21 is a pilot stem 23 positioned relative to a pilot casing 22 and adapted to establish an air loading pressure effective in positioning the valve 13.

The particular construction and functioning of the pilot valve 22 forms the subject matter of the patent to Clarence Johnson No. 2,054,464, and in general is adapted to establish an air loading pressure directly representative of temperature or temperature relation. The arrangement is such that as the pilot stem 23 is positioned vertically in the pilot casing 22 the loading pressure in a pipe 24 leading to the valve 13 is proportionately varied.

The boiler construction illustrated in Fig. 2 provides two superheating sections 25 and 26 respec-

tively joined by a pipe arrangement 27, 28 and 29 through the valve 13, and so arranged that a pipe 30 and desuperheater 31 may be placed in series with the pipes 27, 29 between the superheaters 25, 26.

The desuperheater 31 is located in the water space of the boiler drum 32 so that cooling of the steam passing through the desuperheater 31 is accomplished by heat transfer to the water in the drum 32.

The valve 13 is of such a construction that it may be positioned to completely shut off the desuperheater 31 from the pipe 29 and allow full passage of steam from the superheater 25 through the pipes 27, 28 and 29 to the superheater 26. Alternatively the valve 13 may be partially or completely opened to allow some or all of the steam leaving the superheater 25 to pass through the pipes 27 and 30, through the desuperheater 31, and through the pipe 29 to the superheater 26. Thus by varying the positioning of the valve 13 a control of the flow of steam from the superheater 25, from a condition of all of said steam passing through the desuperheater 31 to a condition of none of such steam passing through the desuperheater 31, may be accomplished. It will be obvious that such a variation in positioning of the valve 13 will result in a varying introduction of desuperheating of the steam between the two superheaters 25 and 26, and thus will be effective in controlling the total temperature of the steam leaving the superheater 26 and passing from the boiler through the conduit 3. This arrangement provides in general a control of the total temperature of the steam leaving the conduit 3 to the throttle mechanism 5 in accordance with the temperature sensitive system 19, 18, 14 and to the desired standard temperature as established by the motor 8.

Inasmuch as the Bourdon tube 14 vertically positions the pilot stem 23 relative to a substantially fixed right-hand end of the beam 21, it will be apparent that if said fixed pivot for the beam 21 is moved to a new location by the motor 8 then a given position of the stem 23 will be accomplished only at a new Bourdon tube position. Thus the motor 8 positions the right-hand end of the floating link 21 to one of two possible positions corresponding respectively to a desired total steam temperature standard of 750° F. or 900° F. As previously explained, the limit switches in connection with the motor 8 insure that once the motor is energized in a given direction of rotation it will continue to operate in that rotation until it reaches the other temperature standard position and the limit switch breaks the circuit of the motor. Thereafter it and the remainder of the temperature control mechanism operates at that temperature standard condition until the other temperature standard condition is called for by some indication of load, for example, by movement of the throttle mechanism 5 with corresponding movement of the contact arm 6, or by actuation of the push button station 12.

It will be appreciated that the necessary adjustments are provided in connection with the arrangement of Figs. 1 and 2 so that the desired temperature standard or standards may be varied or adjusted at will. It will further be appreciated that the arrangement of the contact arm 6 and its cooperating contacts located adjacent the throttle mechanism may be so adjusted that the 750° temperature standard is attained not only for complete operation of the astern turbine but also for the lower range of operation of the ahead turbine if that seems desirable. In fact the contactor may be so arranged that one temperature standard may be attained over any portion of the total operation of the ahead and astern turbines and the other temperature standard over the remaining portion of operation of the two turbines. It will further be appreciated that a completely similar arrangement of mechanism is contemplated in connection with boiler #2 and its turbines of Fig. 1. In the present description it has been assumed that the valve in the crossover line has remained closed. Operation with this valve open is described and claimed in my application Serial No. 347,191, now Patent 2,292,023.

In Fig. 3 I illustrate somewhat diagrammatically in sectional elevation what is commonly known as a high head vapor generator particularly adapted for use in stationary power plants. It is representative however of any natural circulation type of vapor generator provided with two parallel passes for the hot gaseous products of combustion leaving the furnace and wherein a superheating surface 33 (on the drawing of Fig. 3) lies in the left-hand gas pass and generating surface is arranged in the right-hand gas pass. In general, a distribution of the hot gaseous products of combustion through the two passes will determine the total temperature of the steam leaving the superheater 33 to the conduit 3. Such a distribution of gas flow between the two passes is accomplished by the relative positioning of dampers 34 and 35 at the exits of the passes.

The control arrangement is in general similar to that described in connection with Figs. 1 and 2 wherein a bulb 19, connected to a Bourdon tube 14, is sensitive to the total temperature of the steam leaving the boiler and for positioning a pilot 23 relative to a pilot casing 22 to establish an air loading pressure representative of the temperature of the steam and in accordance with preselected standards to which the motor 8 adjusts. In this particular embodiment the pilot valve 22, 23 establishes two separate and distinct loading pressures, the one adapted to increase while the other decreases, with vertical positioning of the stem 23 in the casing 22. These loading pressures are effective respectively through the pipes 36, 37 upon pneumatic actuators 38, 39 for moving the dampers 34, 35.

The operation is such that as the dampers 34 tend to close, the dampers 35 tend to open, and vice versa. Thus simultaneous movement of the two sets of dampers 34, 35 causes a shifting of the proportion of flow of hot gaseous products of combustion through the two passes and relatively more or less heating available at the superheater 33. There is therefore a control of the total steam temperature in the conduit 3 in accordance with the relative positioning of the dampers 34, 35.

In Fig. 4 I illustrate in somewhat diagrammatic fashion another general arrangement of vapor generator, in which I have shown a primary superheater 47 and a secondary superheater 48 connected in series between the boiler drum 49 and the steam discharge conduit 50. Intermediate the superheaters 47, 48 is a desuperheater 51 effective in its action in accordance with the positioning of a damper 52 through the agency of a pneumatic actuator 53. In this general arrangement I have illustrated a possible change in standard of temperature to which the temperature control apparatus functions in dependence

upon rate of steam outflow from the unit as an indication in general of load.

In the conduit 50 I illustrate an orifice or other restriction 54 for producing a pressure differential representative of weight rate of vapor outflow and to which a meter 55 is responsive. The meter 55 is adapted to continuously position a pointer 56 relative to an index 57 to advise the rate of vapor outflow and at the same time the arm 56 engages either the contact segment 58 or the contact segment 59.

The contacts 56, 58 and 59 are connected through the proper relays to control the motor 8 for establishing a temperature control standard to be maintained over predetermined portions of the range of vapor outflow rate. The length of the segments 58, 59 may be varied and will determine what proportion of the flow rate range will dictate a temperature control standard of 900° F. for example and which portion of the flow rate range will dictate a temperature standard of 750° F. to be maintained. The arrangement of Bourdon tube 14 and pilot valve 22 is as previously described in connection with Figs. 2 and 3, and the Bourdon tube 14, sensitive to total temperature of the steam passing through the conduit 50, as well as the motor 8, cooperate in positioning the pilot 22 to establish an air loading pressure effective upon the pneumatic actuator 53 for positioning the damper 52 to maintain a predetermined or desired temperature of the steam passing through the conduit 50. The temperature standard to be maintained may be adjustable as well as the percentage or proportion of the flow rate range over which one standard or the other is to be maintained. In this particular embodiment the weight rate of vapor outflow from the boiler is utilized as an indication of total load upon the unit for establishing the standard to which the temperature control works.

In Fig. 5 I illustrate diagrammatically the use of a desuperheater positioned directly in the vapor discharge conduit 60. The control of this desuperheater is somewhat similar to that illustrated in Fig. 4 through the agency of a temperature sensitive Bourdon tube system 61 and a standard varying motor 8 for positioning a pilot 62 establishing an air loading pressure effective upon the pneumatic actuator 63. In this particular embodiment the motor 8 may be controlled in any one of the ways already illustrated and described.

As previously mentioned, one of the basic reasons for changing the temperature standard to which the temperature control works, in connection with the ahead and the astern turbines of a ship is that the condenser to which said turbines discharge is not capable of standing the relatively higher temperature steam exhausting from the astern turbines if the original high temperature steam (used at the head turbine) is applied to the astern turbine. It is therefore possible to utilize directly the temperature of the exhaust steam entering the condenser from either or both of the turbines as a control dictator for change in standard to which the temperature control on the vapor generator must work.

In Fig. 6 I illustrate the temperature sensitive bulb 67 positioned in the condenser at a location sensitive to the steam entering the condenser from either the ahead or astern turbine and connected to and positioning a Bourdon tube 68. Bourdon tube 68 positions an indicator contact arm 69 relative to two segments 70, 71 for closing circuit either between the wires 66, 65 or 66, 64.

Engagement of the contact arm 69 with either the segment 70 or the segment 71 effects an actuation of relays 7, 11 in the same manner as explained in connection with Fig. 1. The actuation of said relays controls the operation of the motor 8, as previously explained, to establish the temperature standard to which the control of the dampers, desuperheater, or other apparatus at the vapor generator must work.

In this embodiment it will be clear that normal variations in temperature of the steam exhausted from the ahead turbine to the condenser will not cause the contact 69 to move away from the segment 70. If the operation is varied however from the ahead turbine to the astern turbine and the same relatively high temperature standard steam is applied to the astern turbine, then the excessively high temperature of the steam exhausted to the condenser from the astern turbine will cause the Bourdon tube 68 to tend to move counterclockwise and the contact 69 to engage the segment 71, whereby the motor 8 will be actuated to establish the lower temperature standard to which the steam temperature control system of the vapor generator must work.

In Fig. 7 the arrangement contemplates a direct control of the superheated steam temperature from a measure of the temperature of the steam exhausted through the condenser. In other words, in this embodiment there is no establishment of one or another of predetermined temperature standards to which the temperature control is to function, but the pilot valve 72 establishes an air loading pressure directly proportional to the temperature of the exhaust steam entering the condenser, and this air loading pressure is effective directly in positioning the dampers, desuperheater, or other apparatus controlling the total temperature of the steam leaving the vapor generator to one or the other of the turbines. The arrangement is provided with a manual adjustment 73 whereby the standard to which the pilot 72 controls may be varied at will.

Should the temperature of the exhaust steam entering the condenser vary radically from that which is predetermined then the consequent direction and extent of movement of the pilot stem controls the amount, direction, and speed at which the correction is attained. The adjustment is normally made for a normal operating load on the ahead turbine at predetermined temperature standard of say 900° F. Under normal operating load of the astern turbine if 900° steam is admitted to the astern turbine, then the steam exhausting therefrom to the condenser will be at too great a temperature and the air loading pressure established by the pilot 72 will function to reduce the temperature of the steam leaving the boiler and now passing to the astern turbine.

In general it will be seen that I have provided a system, preferably in connection with marine practice, but useful in all types of power systems, wherein under certain conditions of load as may be represented by throttle position, electrical output, rate of vapor outflow, etc., the temperature standard to which the control works is varied to one of predetermined values.

While I have illustrated and described certain preferred embodiments of my invention. I wish it to be understood that I do not expect to be limited thereto except as to the claims.

This application constitutes a division of my copending application Serial No. 347,192 filed in the United States Patent Office July 24, 1940, forfeited and now abandoned.

What I claim as new, and desire to secure by Letters Patent of the United States, is:

1. In combination, a power plant including a vapor generator and two vapor consumers connected thereto, one of the vapor consumers requiring vapor at a predetermined temperature and the other consumer requiring vapor at a different predetermined temperature, a common throttle mechanism for switching the supply of vapor coming from the vapor generator from one to the other of said consumers, and control means positioned by and with the throttle mechanism for establishing the proper related vapor temperature standard to be maintained.

2. In combination, a power plant including a vapor generator and two vapor consumers connected thereto for independent operation, regulating means in connection with said vapor generator for regulating the total temperature of the vapor discharged therefrom, mechanism for switching the supply of vapor from one to the other of said consumers, and control means positioned by and with said mechanism controlling said regulating means.

3. A power plant for a ship comprising in combination, a vapor generator, an ahead turbine and an astern turbine, throttle mechanism for admitting vapor from said generator to the turbines, means controlling the temperature of the vapor leaving the vapor generator to a predetermined standard, and means moved by and with the throttle mechanism for varying the standard.

4. A power plant for a ship comprising in combination, a vapor generator, an ahead turbine and an astern turbine, throttle mechanism for controlling the operation of said turbines, one of said turbines preferably operating at a different vapor temperature standard from that of the other turbine, means controlling the temperature of the vapor leaving the generator to the standard of the turbine it supplies, and means positioned by and with the throttle mechanism to vary the standard to which the temperature control works.

5. The method of controlling the operation of a power plant comprising a vapor generator and two vapor driven prime movers, each requiring vapor of a different temperature, connected thereto for independent operation, which includes, continuously controlling the operation of the vapor generator to maintain either a first or a second predetermined vapor temperature standard, and varying the operation of the vapor generator from said first to said second standard or vice versa in accordance with the load requirement of the prime mover to which vapor is supplied.

6. In combination, a power plant including a vapor generator and two vapor consumers connected thereto for independent operation, regulating means in connection with said vapor generator for regulating the total temperature of the vapor discharged therefrom, means for diverting the vapor produced by the vapor generator from one to the other of said vapor consumers, and means for establishing the total temperature standard of the regulating means in accordance with the load requirement of the vapor consumer to which vapor is diverted.

7. In combination, a power plant including a vapor generator, a plurality of vapor consumers requiring vapor at different predetermined temperatures, a throttle mechanism for connecting said generator selectively to said vapor consumers, means including an element positioned with said throttle mechanism for determining temperature standards to be maintained for said consumers, and means responsive to the temperature of the vapor leaving said vapor generator for maintaining the temperature standard determined.

8. A system for supplying vapor selectively to a plurality of vapor consumers at different predetermined temperatures comprising, in combination, a vapor generator having a heating section, a vapor discharge connection, passage means arranged in parallel for conducting vapor from said heating section to said discharge connection, a vapor cooling device arranged in one of said passage means, means including a throttle mechanism for connecting said discharge connection selectively to said vapor consumers, means responsive to the vapor temperature in said discharge connection for varying the distribution of vapor flow through said parallel passage means in a manner to maintain a predetermined temperature standard, and means including an element positioned with said throttle mechanism for establishing a different temperature standard for each consumer.

9. A system for supplying vapor selectively to a plurality of vapor consumers at different predetermined temperatures comprising, in combination, a vapor generator having two superheating sections connected in series, a desuperheater, means for variably passing vapor from one superheating section through said desuperheater to the other superheater section, means including a throttle mechanism for connecting said other superheating section selectively to said vapor consumers, means responsive to the temperature of the vapor supplied said consumers for varying the vapor flow through said desuperheater, and means including an element positioned with said throttle mechanism for varying the standard of responsiveness of said temperature responsive means.

10. A system for supplying vapor selectively to a plurality of vapor consumers at different predetermined temperatures comprising, in combination, a vapor generator having two parallel gas passes for products of combustion, a vapor heating section arranged in each of said passes, means for connecting said heating sections in series, means including a throttle mechanism connecting one of said heating sections selectively to said consumers for supplying vapor thereto, dampers arranged to control the flow of gases through said passes and operating to increase the flow through one pass while decreasing the flow through the other, means responsive to the temperature of the vapor supplied said consumers for controlling said dampers, and means including an element positioned with said throttle mechanism for varying the standard of responsiveness of said temperature responsive means.

PAUL S. DICKEY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
12,355	Storm	Feb. 6, 1855
933,577	Penniman	Sept. 7, 1909
1,093,161	Wilkinson	Apr. 14, 1914
1,096,128	Rosenthal	May 12, 1914

(Other references on following page)

UNITED STATES PATENTS

Number	Name	Date
1,119,318	Rosenthal	Dec. 1, 1914
1,328,997	Jacobus	Jan. 27, 1920
1,338,922	Hopwood	May 4, 1920
1,387,463	Broido	Aug. 16, 1921
1,387,853	Larson	Aug. 16, 1921
1,671,686	Smoot	May 29, 1928
1,743,621	Quinn	Jan. 14, 1930
1,798,894	Noack	Mar. 31, 1931
1,883,015	Shipley	Oct. 18, 1932
1,894,246	Stein et al.	Jan. 10, 1933
1,897,845	Hilgers	Feb. 14, 1933
1,920,781	Coughey	Aug. 1, 1933
1,927,892	Jones	Sept. 26, 1933
1,973,721	Lucke et al.	Sept. 18, 1934
2,016,317	Dahl	Oct. 8, 1935
2,050,279	Dahl	Aug. 11, 1936
2,055,033	Kingsland	Sept. 22, 1936

Number	Name	Date
2,103,685	Kuhner	Dec. 28, 1937
2,119,153	Dällenbach	May 31, 1938
2,131,058	Lucke	Sept. 27, 1938
2,133,991	Kerr	Oct. 25, 1938
2,143,356	Miller et al.	Jan. 10, 1939
2,156,610	Kerr	May 2, 1939
2,165,175	Dickey	July 4, 1939
2,170,345	Bailey et al.	Aug. 22, 1939
2,184,224	Lucke	Dec. 19, 1939
2,193,114	Seippel	Mar. 2, 1940
2,204,144	Shimer	July 11, 1940
2,212,115	Ebbets et al.	Aug. 20, 1940
2,222,348	Moore et al.	Nov. 19, 1940
2,226,219	Cook et al.	Dec. 20, 1940
2,231,843	Shimer	Feb. 11, 1941
2,256,797	Walker	Sept. 23, 1941
2,258,385	Hartmann-Riis	Oct. 7, 1941
2,298,700	Junkins et al.	Oct. 13, 1942