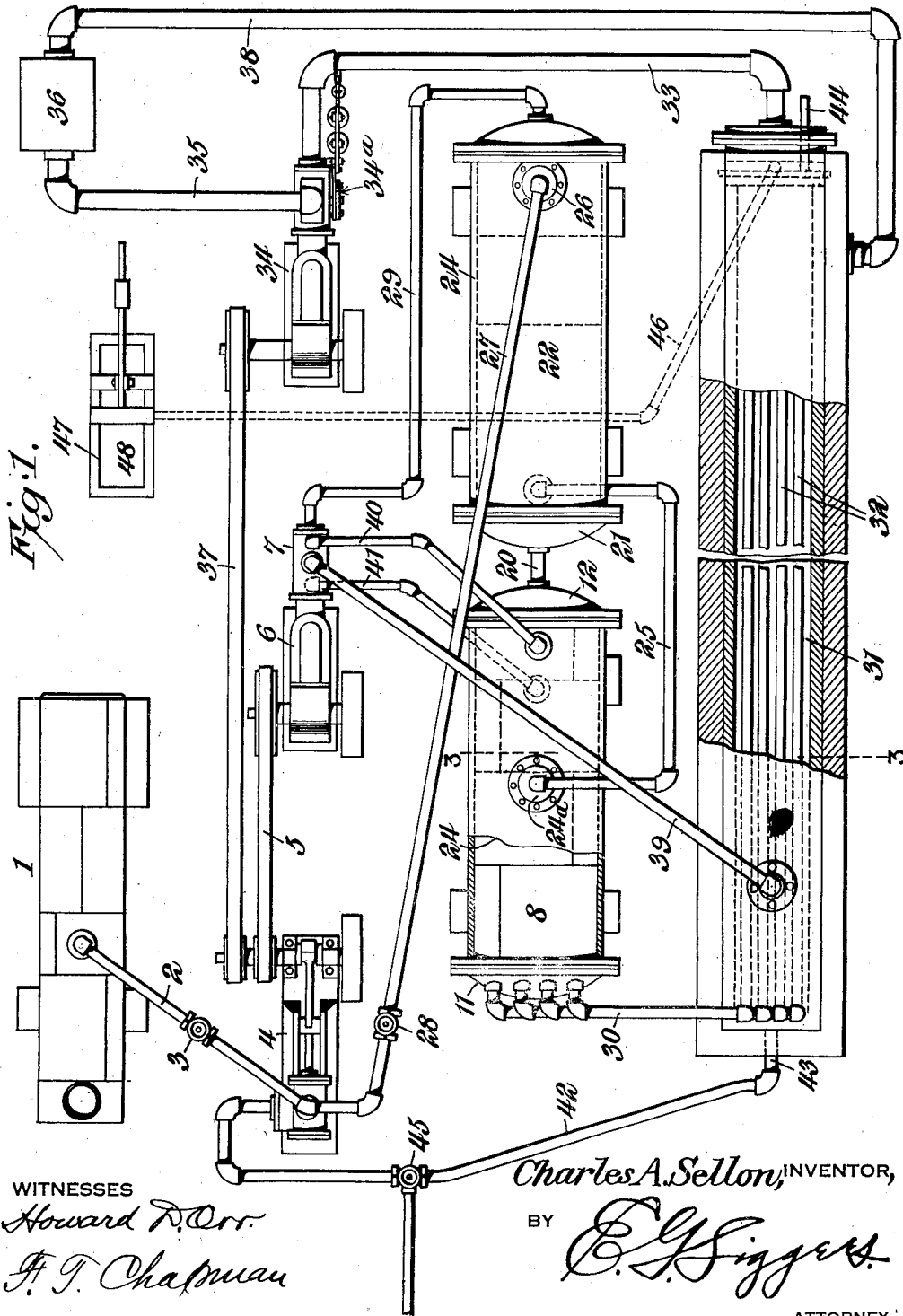


C. A. SELLON.
 PROCESS AND SYSTEM FOR PRODUCING POWER.
 APPLICATION FILED NOV. 7, 1913.

1,103,440.

Patented July 14, 1914.

3 SHEETS—SHEET 1.



WITNESSES

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Charles A. Sellon, INVENTOR,

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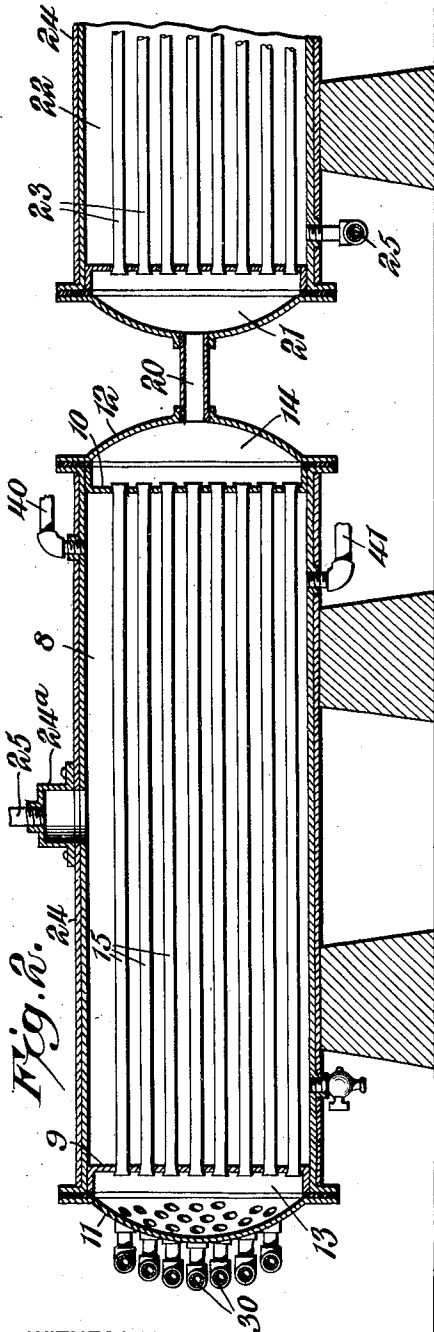


Fig. 2.

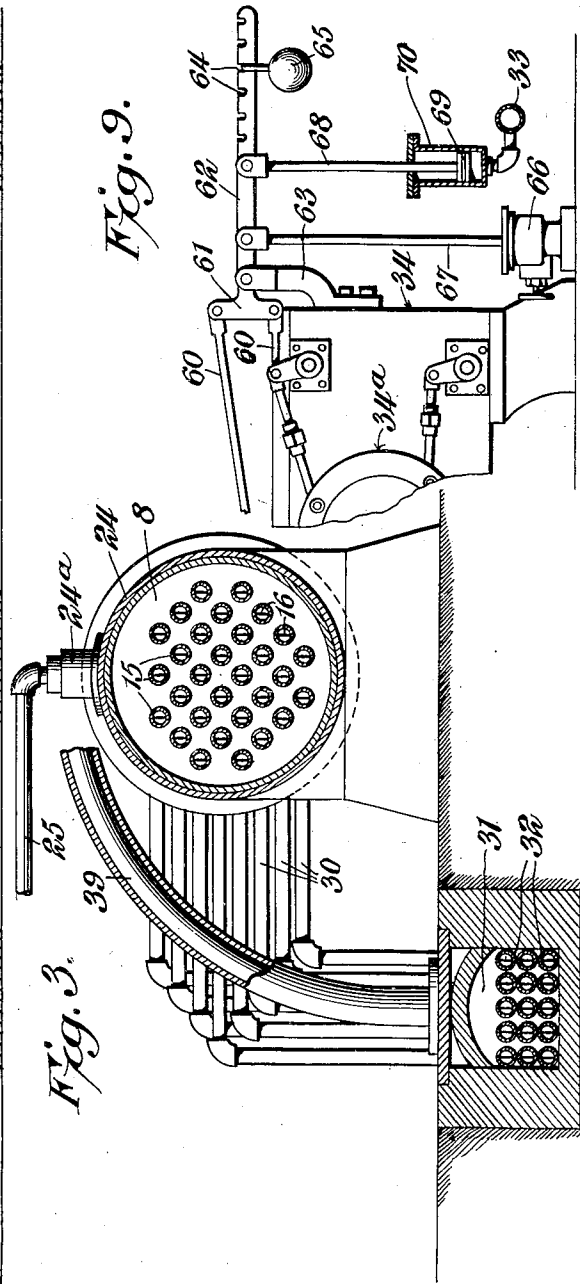


Fig. 3.

Fig. 9.

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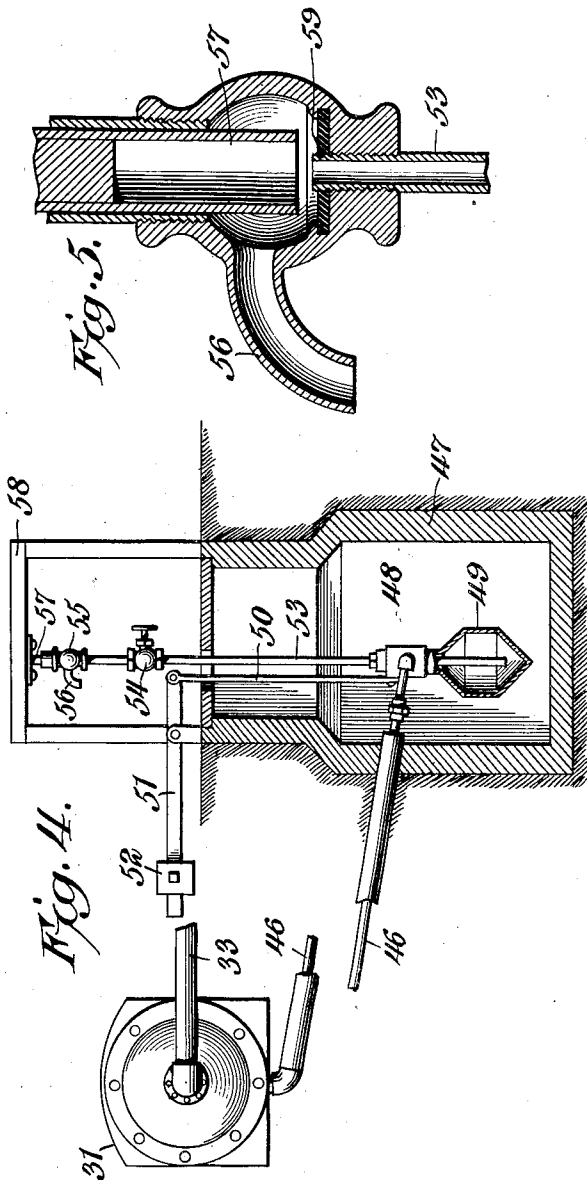


Fig. 5.

Fig. 4.

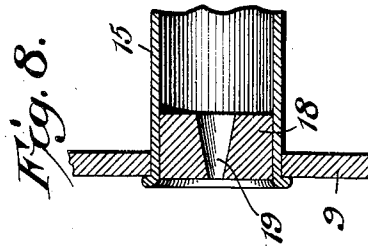


Fig. 8.

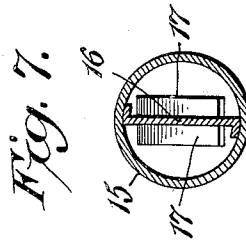


Fig. 7.

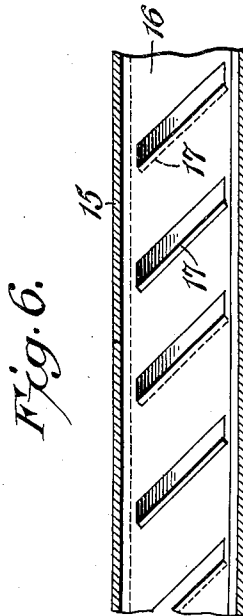


Fig. 6.

WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES A. SELLON, OF ALLIANCE, OHIO.

PROCESS AND SYSTEM FOR PRODUCING POWER.

1,103,440.

Specification of Letters Patent.

Patented July 14, 1914.

Application filed November 7, 1913. Serial No. 799,788.

To all whom it may concern:

Be it known that I, CHARLES A. SELLON, a citizen of the United States, residing at Alliance, in the county of Stark and State of Ohio, have invented a new and useful Process of and System for Producing Power, of which the following is a specification.

This invention has reference to improvements in the process of and system for producing power, and its object is to utilize heat caused by compressing air to raise the temperature of water or other liquid to a point where it will assume a condition permitting the utilization of the power so generated, and also to use the expansive force of the compressed air for power and other purposes.

The invention consists in compressing air to a comparatively high degree, whereby its temperature is raised to a considerable extent and the hot air is then passed first through a superheater, and then through water to raise the temperature of the water to the steaming point, and to superheat the steam so generated, while from the water container the air which is still hot, though not so hot as when it leaves the compressor, is caused to travel in heat traversing relation to air approaching the compressor, so that a proportion of the heat of the still hot or warm air under compression is transmitted to the air about to be compressed, thus cooling the compressed air and warming the relatively uncompressed air as it approaches the compressor, so that the initial temperature of the air before it reaches the compressor is raised and consequently the temperature of the air being compressed is raised more than it would be if not initially heated. After passing the transfer where the compressed air loses part of its heat and such heat is transferred to the air about to be compressed, the cooled compressed air is led through an expanding apparatus where the cool compressed air is allowed to expand, thus greatly reducing its temperature and the then cold air may be utilized for refrigerating purposes, after which the air is directed through the transfer back to the compressor. The expander may be in the form of an air engine and may be employed to assist in the primary compression of the air.

The compressor may be, and preferably is driven by a steam engine receiving steam from an ordinary boiler or other steam

generator and the exhaust steam may also be directed through the transfer to assist in the preheating of the air fed into the compressor. Such steam as may be generated by the heat of the compressed air may be directed to the steam engine to assist in driving it and so economize the demand upon the primary steam generator or boiler supplying the steam engine with steam.

The invention will be best understood from a consideration of the following detailed description, taken in connection with the accompanying drawings forming a part of this specification, with the further understanding that while the drawings show a practical embodiment of the invention, the latter is not confined to any strict conformity with the showing of the drawings, but may be changed and modified so long as such changes and modifications mark no material departure from the salient features of the invention.

In the drawings: Figure 1 is a plan view with some parts in section, of a plant or installation for the practice of the present invention, the plant being more or less schematically displayed. Fig. 2 is a longitudinal section through the secondary boiler and through a portion of the superheater. Fig. 3 is a section on the line 3—3 of Fig. 1. Figs. 4 to 9 are views mostly in section of details of construction of the plant.

In the drawings there is shown a boiler 1 which may be taken as indicative of any suitable steam generator capable of producing sufficient steam for the purposes of the present invention. Leading from the boiler is a steam pipe 2 including a valve 3 and serving to conduct steam to a steam engine 4 of any suitable type, and this engine is connected by a belt 5 to a compressor 6, and said compressor may also be of any suitable type. The compressor is provided with a compressor cylinder 7 which may be considered as provided with the usual cooling jacket. There is also provided another container 8 which may in general follow the lines of an ordinary steam boiler except that no heating furnace is provided. The container 8 is designed to contain a liquid which may be raised to the gaseous or vaporous state by comparatively moderate temperature, and such liquid is best typified by water, which for practical purposes is advantageous over any other liquid, wherefore to simplify the description it will be consid-

ered that the container 8 is supplied with a suitable quantity of water without necessarily limiting the practice of the invention to such particular liquid, and it is for this reason that the container 8 may and will hereinafter be termed a boiler. Interior walls or heads 9, 10, respectively, are provided for the boiler 8 and these heads or walls are located near opposite exterior heads 11, 12, thus defining chambers 13, 14 at opposite ends of the boiler. Extending from the head 9 to the head 10 is a series of pipes 15 opening at their ends into the respective chambers 13 and 14 and closed to the main body of the boiler between the heads 9 and 10. These pipes 15, of which a portion of one is shown in Figs. 6 and 7, the latter being a cross section of the structure shown in Fig. 6, are each divided into two parts by an interior longitudinal wall 16 on opposite sides of which are inclined baffles 17 so that a fluid traversing the pipe 15 is diverted against the walls of the pipe to facilitate heat interchange. The baffles are preferably inclined to the vertical and the wall or web 16 is preferably placed upright. Moreover, each pipe or flue 15 at the outlet end is provided with a plug 18 in which there is formed a central passage 19 expanding toward the flue. The baffles 17 and the plug 18 in each flue contribute to the equitable distribution to the flues of fluid traversing them.

The chamber 14 of the boiler 8 is connected by a pipe 20 with an end chamber 21 in another boiler-like vessel 22, which may be constructed in substantially all respects, except as hereinafter described, like the boiler 8 and the vessel 22 has flues 23 extending therethrough, and both said vessel 22 and the boiler 8 may have a covering 24 of heat insulating material. The vessel 22 because of its purpose will hereinafter be called a superheater and the reason for this term will appear farther on.

The boiler 8 is provided with a steam dome 24* and this is connected by a pipe 25 with a low point, say, through the bottom of the superheater 22, where it opens into the body portion of the superheater traversed by the flues 23. At the other end from the point of entrance of the pipe 25 the superheater is provided with a dome 26 connected by a pipe 27 to the intake of the steam engine 4, and this pipe 27 is provided with a controlling valve 28.

The outgoing side of the compressor cylinder 7 is connected by a pipe 29 to that end chamber of the superheater remote from the chamber 21, and that end of the boiler 8 containing the chamber 13 has connected thereto a battery of pipes 30 leading into a conduit 31 which may be sunk into the ground or suitably protected against the escape of heat by radiation. The pipes 30

connect to a battery of pipes 32 which may be constructed like the flues 15 already described, and these pipes lead into a chamber at the other end of the conduit 31 where they all connect in multiple to a pipe 33 in turn leading to an expander 34 from which the expanded air is directed by a pipe 35 to a refrigerating apparatus 36, which because it may be of ordinary construction, is not shown in detail, but merely indicated in the drawings. The expander 34 may take the form, and in the drawings is indicated in the form of an air engine connected by a belt 37 to the drive shaft of the engine 4.

The refrigerating apparatus 36 is connected on the discharge side to a pipe 38 leading into the conduit 31 at the end thereof remote from that entered by the pipes 30, and near the point where the pipes 30 enter in pipe 39 is connected to the conduit 31, and this pipe leads to the intake of the compressor 6.

The cooling jacket of the cylinder 7 of the compressor 6 is connected by pipes 40, 41 to the boiler 8 and the exhaust side of the steam engine 4 is connected by a pipe 42 to another pipe 43 leading through the conduit 31 and finally exhausting by way of an outlet pipe 44 at the other end of the conduit. The pipe 42 includes a valve 45 by means of which the exhaust steam may be directed through the conduit 31 or directly to the air before reaching the conduit.

There is more or less condensation in the conduit or transfer 31, and this is led by a pipe 46 to a trap 47. The pipe 46 leads into a pit 48 and there opens into a water trap 49 suspended by a link 50 on one end of a lever 51 carrying an adjustable weight 52. The trap 49 is provided with an outlet pipe 53 leading upwardly and including a controlling valve 54. The upper end of the pipe 53 carries a globular member 55 provided with an outlet spout 56, and this globular member is arranged to travel along a fixed valve member 57 which may be carried by a support 58 over the pit 48, the arrangement being such that when a sufficient amount of water shall accumulate within the water trap 49 the weight 52 will be overbalanced thus moving the globular member 55 along the fixed valve member 57 so as to carry a seat 59 within the globular member away from the lower end of the fixed valve member 57, thereby opening the upper end of the pipe 53 to communicate with the outlet spout 56 when pressure within the water trap will force any accumulated water out through the spout 56 until the weight of the water within the trap is overbalanced by the adjustable weight 52, in which case the valve seat 59 is again brought into engagement with the fixed valve member 56.

In order to maintain the speed of the expander 34 constant under variations in pres-

sure in the compressed air system, it is provided with a governor shown in detail in Fig. 9. The expander is preferably provided with a Corliss valve gear indicated at 34^a, and this valve gear has governor rods 60 connected respectively to the opposite ends of the angle end 61 of a lever 62 fulcrumed in a bracket 63 which may be fast to the expander 34. The longer arm of the lever 62 is notched as at 64 or may be otherwise formed to carry an adjustable weight 65. A dash pot 66 is connected to the lever 62 by a rod 67 to prevent overriding of the lever. The lever 62 is also connected to one end of a rod 68 at the other end of which is a piston 69 in a cylinder 70 connected to the pipe 33. Any variation of pressure in the pipe 33 acts upon the piston 69 and through it upon the lever 62 to regulate the valve gear 34^a in a manner to maintain the speed of the expander constant.

The process is practised as follows: Steam is generated in the boiler 1 to a suitable pressure and is conducted by the pipe 2 to the engine 4, the flow of steam through the pipe 2 being under the control of the valve 3. The steam supply causes the actuation of the engine 4 and this engine drives the compressor 6 through the intermediary of the belt 5. This causes air to be compressed and the temperature of the air is correspondingly raised; as is well known. The hot air is conducted through the pipe 29 into the superheater 22 and in traveling through the superheater it passes in multiple through the flues 23, and then passes to and through the flues 15 of the boiler 8. The interior of the boiler 8 contains a suitable supply of water which may be taken as typical of any suitable liquid, and the hot air in passing through the flues 15 loses some of its heat which is transferred to water. The air although somewhat cooler than when leaving the compressor, is still hot, and flows by way of the pipes 30 through the pipes 32 of the transfer and ultimately reaches the pipe 33 and by way of the latter is directed to the expander or air engine 34 where it is allowed to perform work because of its expansion, and the power so generated is returned to the power shaft of the steam engine 4 to assist the latter in driving the compressor. The expanded air now very cold is directed through the refrigerator or ice machine 36 and the cold air leaving the refrigerating apparatus is conducted by way of the pipe 38 into the transfer 31 at the compressed air outlet end thereof. The cold air travels through the transfer 31 in contact with the pipes 32 carrying hot compressed air, and cools such air by the transfer of heat from the hot air to the cold air surrounding the pipes 32 so that by the time the cold air reaches the pipe 39 it has become noticeably warm and this warm air is directed by the

pipe 39 to the intake of the compressor; wherefore the air entering the compressor is preheated and is therefore noticeably hotter when compressed than would be the case with atmospheric or relatively cold air.

To aid in heating the air in the transfer the exhaust steam from the engine may be directed through the transfer by the pipes 42 and 43, finally escaping to the atmosphere through the exhaust pipe 44, so that what heat there may be in the exhaust steam is utilized to an extent in the preheating of the air fed to the compressor. Now, the air leaving the compressor contains a large number of heat units per volume, and this air ultimately raises the water in the boiler 8 to the steaming point, and the steam so generated is carried by the pipe 25 into the superheater 22 where it is acted upon by the hot portion of the compressed air and the steam becomes superheated, and this steam may be directed to the engine 4 to assist the steam supply from the boiler 1 and therefore requiring a smaller demand upon the boiler than would be the case if the compressed air were simply cooled without the saving or utilization of the heat units ordinarily lost when compressed air is cooled preparatory to passing through the refrigerating machine. Moreover, the expander also utilizes the energy of the air which has heretofore been lost or wasted, so that some of the heretofore lost energy is returned to the compressor in the shape of driving power assisting the engine 4 and to a commensurate extent lowering the demand for steam upon the boiler 1.

By the present invention a considerable proportion of energy heretofore lost in refrigerating plants in the preliminary cooling of the compressed fluid is recovered and returned to the prime mover, so that the actual amount of energy demanded upon the prime source of energy, namely, the boiler, is more nearly in accordance with the energy demanded by the refrigerating machine instead of representing several times such energy.

Air has been taken as an example of the fluid which may be utilized in the system, but it will be understood that any other suitable fluid may be employed, and the recovery of heretofore lost energy by the process of the present invention and the system for utilizing it is more than sufficient to pay for the installation and its operation, together with the incidental losses due to friction, radiation and the like.

With respect to loss of energy by radiation it will be understood that wherever parts are liable to radiation losses heat insulating coverings are provided. If the recovered energy is desired for other purposes, then instead of utilizing the recovered energy to reduce the demand upon the

boiler 1, the power represented by steam generated in the boiler 8 and by the expansion of air in the expander 34 may be directed otherwise than indicated in the drawings.

In the claims the terms air and water are to be understood as including other gases or liquids suitable for the purpose.

What is claimed is:—

1. The process of producing and utilizing power which consists in raising the temperature of air by compressing it, then passing the hot compressed air through water to raise the temperature of the latter, then causing the air to expand and utilizing the lowered temperature thereby produced for refrigerating purposes, and returning the expanded air to the point of compression and at the same time preheating the expanded air by heat transference from the compressed air.

2. The process of producing and utilizing power, which consists in raising the temperature of air by compressing it, converting a portion of the heat so obtained into power by passing the hot air into heating relation to water, then causing the air to expand and utilizing the lowered temperature for refrigerating purposes and returning the expanded air to the point of compression in heat transferring relation to the heated air before expansion.

3. The process of producing and utilizing power, which consists in raising the temperature of air by compressing it, converting a portion of the heat so obtained into power by passing the hot air into heating relation to water, then causing the air to expand and utilizing the lowered temperature for refrigerating purposes, returning the expanded air to the point of compression in heat transferring relation to the heated air before expansion, and utilizing the expansion of the air for the generation of power other than refrigeration.

4. The process of producing and conserving power, which consists in raising the temperature of air by compressing it, then passing the hot compressed air through water to raise the temperature of the latter, then carrying the compressed air through an air motor to utilize mechanical energy represented by the expansion, then passing the expanded air through refrigerating apparatus, and finally returning the expanded air to the point of compression in heat transferring relation to the hot air before expansion to preheat the expanded air.

5. The process of producing and conserving power, which consists in raising the temperature of air by compressing it, then passing the hot compressed air through water to raise the temperature of the latter, then carrying the compressed air through an air motor to utilize mechanical energy represented

by the expansion, then passing the expanded air through refrigerating apparatus, and finally returning the expanded air to the point of compression in heat transferring relation to the hot air before expansion to preheat the expanded air, the energy represented by the raising of the temperature of the water and by the mechanical action of the expanding air being utilized to assist in the initial compression of the air.

6. The process of producing power, which consists in raising the temperature of air by compression, then passing the hot compressed air in a plurality of streams through water to raise the temperature of the latter, and then utilizing the hot air after passing through the water to preheat air passing to the compressor.

7. The process of producing and conserving power, which consists in raising the temperature of air by compression, utilizing a portion of the heat of the compressed air to heat water for the production of steam, utilizing a portion of the heat remaining in the compressed air to preheat air passing to the compressor, and utilizing the energy of the steam produced by the heating of the water.

8. The process of producing power, which consists in compressing air to heat it, utilizing a portion of the heat so produced to convert water into steam, causing the compressed air to expand, and utilizing the effect thereof, and finally directing the expanded air into heat absorbing relation to the heated air before expansion for the utilization of a portion of the heat of the heated air to preheat the expanded air on its return to the compressor.

9. The process of producing power, which consists in raising the temperature of air by compression, utilizing a portion of the heat of compression for converting water into steam for the utilization of its power, causing an expansion of the compressed air and utilizing the power developed thereby, and returning the expanded air to the compressor in heat transferring relation to the compressed air after heating the water to cool the compressed air and preheat the expanded air passing to the compressor.

10. The process of producing power, which consists in compressing air to raise its temperature, utilizing a portion of the energy represented by the heated compressed air for useful work and thereby cooling the air, expanding the compressed air and utilizing a portion of the energy so developed for useful work, utilizing the expanded air for refrigerating purposes, and returning the expanded air to the point of compression and utilizing a portion of the heat of the compressed air for preheating the expanded air.

11. The process of producing power, which consists in compressing air to raise

its temperature, converting a portion of the energy represented by the compressed air by expansion into useful work, converting a portion of the energy represented by the heat of the compressed air into useful work, returning the expanded air to the compressor, and utilizing a portion of the energy represented by the heat of the compressed air for preheating the expanded air before compression, and directing the energy utilized for useful work to assist in the initial compression of the air.

12. The process of producing power, which consists in compressing air to increase its temperature, utilizing a portion of the heat so produced for heating water in a boiler to generate steam, and utilizing the steam for useful work, passing the heated compressed air after acting upon the water through a heat transfer, causing the compressed air to expand for useful work and refrigeration, and returning the expanded air through the heat transfer to the compressor to heat the air before compression.

13. The process of producing power, which consists in compressing air to increase its temperature, utilizing a portion of the heat so produced for heating the water in a boiler to generate steam, utilizing the steam so produced for assisting in the initial compressing of the air, passing the heated compressed air after acting upon the water through a heat transfer, causing an expansion of the compressed air, converting a portion of the energy so produced for assisting in the initial compression of the air, utilizing the energy represented by the expanded air and not otherwise utilized for useful work, and returning the expanded air to the compressor through the heat transfer.

14. The process of producing power, which consists in compressing air to increase its temperature, utilizing a portion of the heat so produced for heating water in a boiler to generate steam, and also utilizing a portion of such heat to preheat steam so generated, utilizing the steam for useful work, passing the heated compressed air after acting upon the water through a heat transfer, causing an expansion of the air after passing through the heat transfer for the production of mechanical motion, utilizing the energy of the expanded air not utilized for the production of mechanical motion for the production of other useful work, and returning the expanded air through the heat transfer and from thence to the compressor.

15. A system for the production and conservation of power, which consists of a steam generator, a steam engine arranged

for actuation thereby, an air compressor arranged for actuation by the steam engine, a boiler and superheater connected to the outlet side of the air compressor for the production of steam and the superheating thereof, a heat transfer receiving the compressed air after leaving the boiler, an air engine or expander receiving the compressed air after leaving the transfer, means for utilizing the expanded air after leaving the air engine, and means for returning the expanded air through the heat transfer to the intake of the compressor.

16. A system for the production and conservation of power, comprising a steam boiler, a steam engine fed thereby, an air compressor driven by the steam engine, a superheater and steam boiler connected to the outlet of the compressor in the order named, a heat transfer receiving compressed air after passing through the superheater and boiler, an air engine or expander receiving the compressed air after leaving the transfer, and connected to the steam engine for assisting the latter, and a refrigerating apparatus connected to the expander for the utilization of the lower temperature produced by the expanded air, means for returning the expanded air to the compressor through the transfer, and means for directing steam produced by the hot air to the steam engine to assist in the actuation thereof.

17. A system for the production and conservation of power, comprising a steam boiler, a steam engine fed thereby, an air compressor driven by the steam engine, a superheater, and steam boiler connected to the outlet of the compressor in the order named, a heat transfer receiving compressed air after passing through the superheater and boiler, an air engine or expander receiving the compressed air after leaving the transfer, and connected to the steam engine for assisting the latter, and a refrigerating apparatus connected to the expander for the utilization of the low temperature produced by the expanded air, means for returning the expanded air to the compressor through the transfer, and means for directing steam produced by the hot air to the steam engine to assist in the actuation thereof, the system also including means for directing exhaust steam from the steam engine through the heat transfer in the same direction as the passage of heated air therethrough.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

CHARLES A. SELLON.

Witnesses:

L. W. JUDGE,
J. C. HUBBARD.