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POWER RECOVERY SYSTEM

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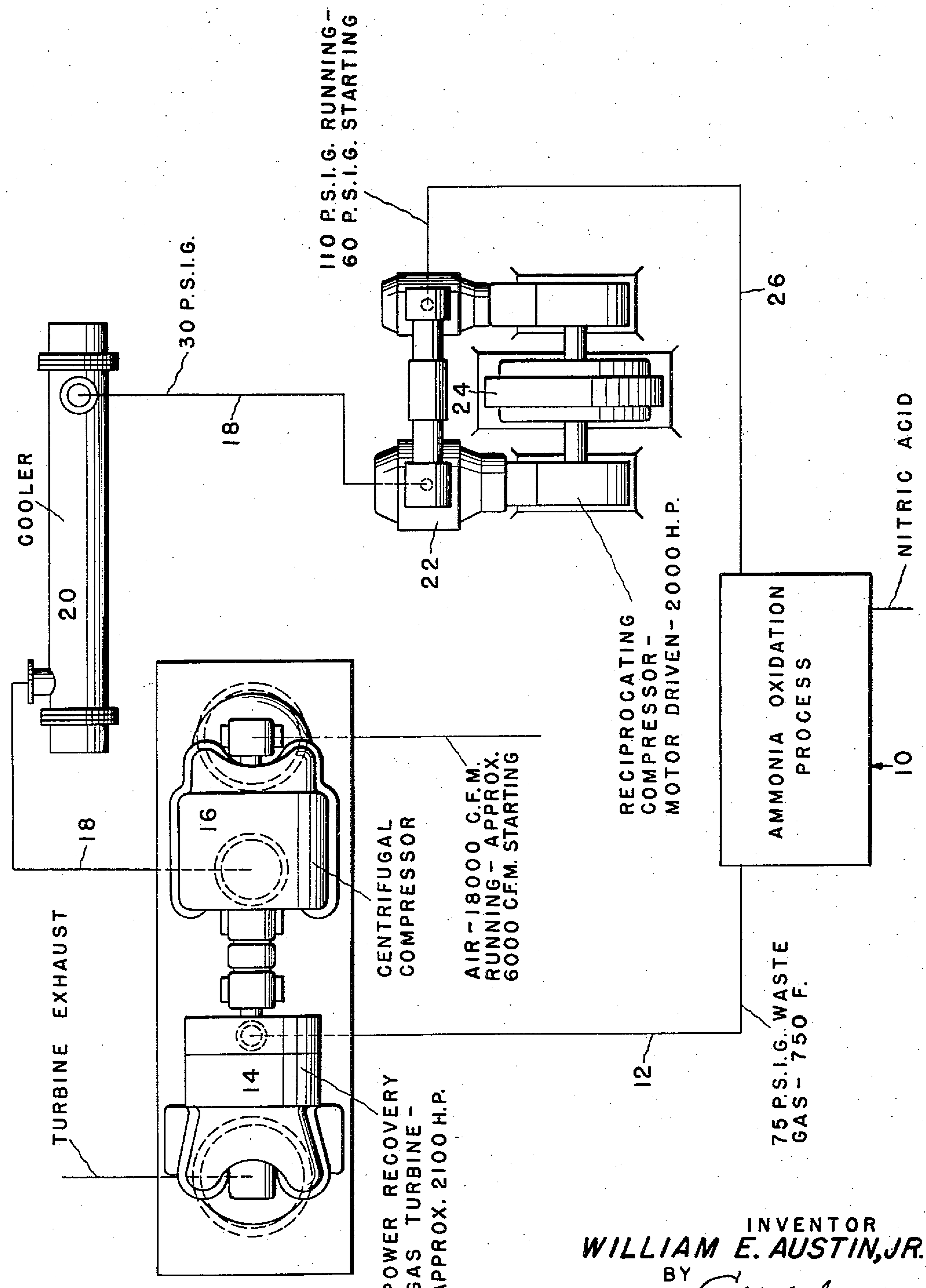

INVENTOR
WILLIAM E. AUSTIN, JR.
BY [signature]
HIS ATTORNEY

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POWER RECOVERY SYSTEM

William E. Austin, Jr., Memphis, Tenn., assignor to Ingersoll-Rand Company, New York, N. Y., a corporation of New Jersey

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5 Claims. (Cl. 23—260)

This invention relates to a power recovery system, and more particularly to a power recovery system for use with a chemical process requiring a supply of gas under pressure and having a waste exhaust of gas having a relatively high energy content.

It is one object of this invention to substantially reduce the power requirement independent of the system.

It is a further object of the invention to recover a substantial part of the energy in such waste gas and utilize it in compressing gas for use in the process.

Further objects will become apparent from the following specification and drawing, in which the power recovery system is shown schematically.

The power recovery system shown in the drawing is connected, by way of illustration, in an ammonia oxidation process 10. In this process compressed air at approximately 110 p. s. i. g. (pounds per square inch gauge) is supplied to the process wherein the ammonia is oxidized producing nitric acid and having a waste gas under pressure of approximately 75 p. s. i. g. and a temperature of approximately 750° Fahrenheit. This waste gas is conducted through a line 12 to drive a motor, such as a power recovery gas turbine 14. The turbine 14, in turn, is connected to drive a centrifugal compressor 16 arranged to pump air from atmospheric pressure and discharge it at a higher pressure through a line 18 and intercooler 20 to a reciprocating compressor 22 driven by an electric motor 24. The compressor 22 is connected by a line 26 to supply air at 110 p. s. i. g. to the oxidation process. A two stage reciprocating compressor is shown, but it is to be understood that in some installations a single stage compressor would be satisfactory, the number of stages of the reciprocating compressor being determined entirely by the requirements of the process with which it is associated.

The legends on the drawing specify by way of illustration only the various air volumes and pressures and the horsepowers of the motors for starting and running the process. However, these legends point out one requirement of the system and at least one advantage of the system. More particularly it is noted that the centrifugal compressor is merely floating on the line so that at the start of the process this compressor does no work as there is no waste gas to drive the turbine. Accordingly the reciprocating compressor 22 and associated driving motor 24 must be of sufficient size and capacity to supply a sufficient amount of compressed air at the minimum pressure required to start the ammonia oxidation process. For example in the system disclosed this is approximately 6000 cubic feet per minute of air at the intake of the compressor and discharged at 60 p. s. i. g.

Once the oxidation process has started, there is of course some waste gas. This waste gas will start the operation of the turbine 14 such that the centrifugal compressor 16 will supply air to the reciprocating compressor 22 at a pressure in excess of atmospheric. Accordingly the pressure and quantity of air discharged by the reciprocating compressor 22 will increase thereby increasing the waste gas energy of the process. This action is cumulative until the gas turbine and centrifugal compressor are operated at their rated speeds and normal conditions exist in the ammonia oxidation process. In the system shown by way of illustration, the centrifugal compressor 16 will then draw in 18,000 cubic feet of air per minute from the atmosphere and discharge it at approximately 30 p. s. i. g. This air is then further compressed to 110 p. s. i. g. by the reciprocating compressor and supplied to the oxidation process.

It is to be noted that with this system that approximately one half of the power requirements for compressing air is obtained from the energy of the waste gas—i. e., the gas turbine horsepower is approximately equal to the independently driven motor 24. Moreover, regardless of this horsepower relation, it is clear that a smaller motor 24 may be used than in cases where there is no power recovery system.

While I have shown and described a specific form of my invention, it is to be understood that various changes and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. The combination adapted for use with a chemical process requiring a supply of fluid under pressure and having a waste exhaust with a relatively high energy content, comprising a motor adapted to be connected to said process to be driven by such exhaust, a compressor driven by said motor, and at least one other motor driven compressor having its intake connected to receive compressed fluid from the first said compressor and to supply such fluid under a higher pressure to the process.

2. The combination claimed in claim 1 in which the second said compressor is capable of compressing fluid from substantially atmospheric to a pressure value sufficient to start said process.

3. The combination claimed in claim 1 in which the second said compressor has a maximum discharge capacity when the intake pressure is substantially atmospheric, which is considerably below the desired capacity for normal operation of the process but is of sufficient value to initiate the process.

4. The combination claimed in claim 1 in which the first said motor is of the gas turbine type and the first said compressor is of the centrifugal type.

5. The combination adapted for use with an ammonia oxidation process requiring a supply of air under pressure and having a waste exhaust with a relatively high energy content, comprising a gas turbine adapted to be driven by such waste exhaust, a centrifugal compressor connected to be driven by said turbine, at least one other compressor having its inlet connected to the discharge of said centrifugal compressor and its discharge connected to supply air under pressure to said process, and a motor connected for driving said other compressor, the last said compressor adapted to compress air of substantially atmospheric pressure to a value sufficient for initiating said process, the maximum combined capacities of the first said and the second said compressors having a value required for supplying air under pressure to said process for normal operation thereof.

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