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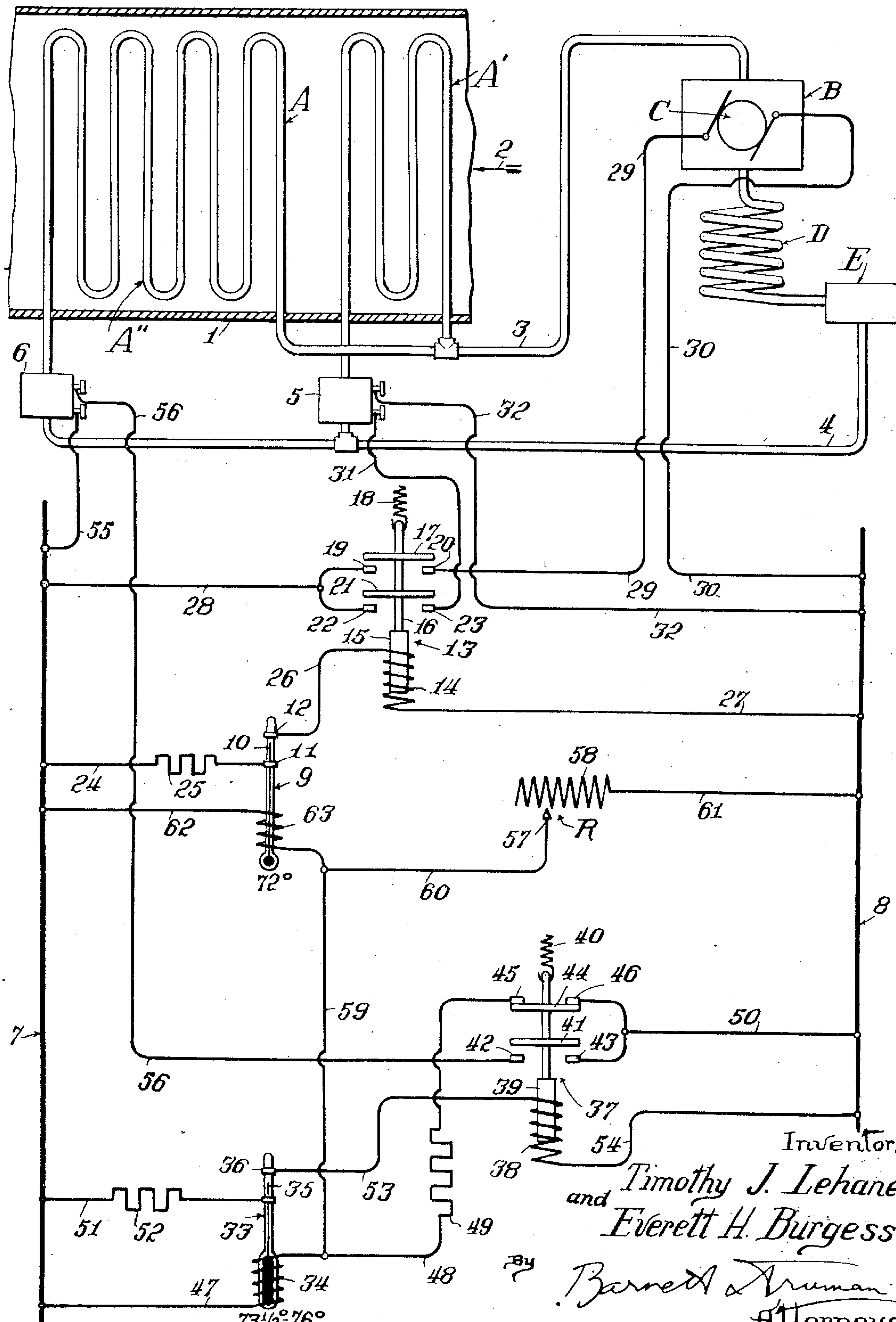

Inventors
Timothy J. Lehane
and
Everett H. Burgess

By Barnett & Truman
Attorneys

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SPLIT EVAPORATOR FOR COOLING SYSTEMS

Timothy J. Lehane and Everett H. Burgess, Chicago, Ill., assignors to Vapor Car Heating Company, Inc., Chicago, Ill., a corporation of New York

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6 Claims. (Cl. 62—8)

This invention relates to certain new and useful improvements in a cooling or refrigerating system, and more particularly to an improved evaporator or heat absorber. This evaporator may be known as a "split evaporator," that is, it comprises a plurality of separately operating sections which may be used singly or simultaneously so as to vary the effective area of the evaporator. Also one or more of the sections may be controlled by a "cycling" thermostat so as to cause the refrigerant to be supplied in successive separate impulses, these impulses increasing in number or duration as the temperature increases in the control space until, at a maximum temperature, the flow of refrigerant is continuous and the evaporator section is utilized to its full capacity. In this way the effectiveness of the complete evaporator may be varied between rather wide limits with a consequent flexibility and efficiency.

The principal object of this invention is to provide an improved evaporator for a cooling system, as briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved split evaporator comprising a plurality of separately controlled sections.

Another object is to provide an improved thermostatic control system for the refrigerating apparatus.

Another object is to provide improved means for correcting the predetermined temperatures at which the different evaporator sections are successively effective.

Other objects and advantages of this invention are more apparent from the following detail description of one approved form of apparatus assembled and operating according to the principles of this invention.

The accompanying drawing is a partially diagrammatic and partial sectional view of the refrigerating system, and the electrical and thermostatic control mechanism cooperating therewith.

The improved evaporator A is housed in a conduit, shown partially at 1, through which air is propelled in contact with the evaporator, as indicated by the arrow 2, although the direction of this air flow could be reversed. The evaporator comprises a pair of separate sections or coils indicated at A′ and A″, these sections being arranged in parallel in the refrigerant circulation system. The smaller coil A′ may represent about 25% of the capacity of the total cooler A, whereas the coil A″ has a maximum capacity of 75%. The evaporated refrigerant is drawn by suction through the pipe 3 into the compressor B driven by the motor C. The compressed refrigerant is discharged into the condenser D wherein it is cooled and flows in liquid form into the receiver E from which the liquid refrigerant flows out through pipe 4 to either or both of the magnetically actuated valves 5 and 6 which control the flow of refrigerant into the evaporator sections A′ and A″, respectively.

In the lower half of the figure is indicated diagrammatically the electrical control mechanism. The positive and negative electrical supply mains are indicated at 7 and 8, respectively.

At 9 is shown a mercury-column thermostat which is located so as to respond to the temperature changes in the controlled space, that is it may be positioned in the path of the air in conduit 1 after it has flowed in contact with the evaporator A. This thermostat is so constructed that at some predetermined temperature, for example 72° F., the mercury column 10 which is constantly in contact with the lower fixed terminal 11 will engage an upper terminal 12 so as to complete an electric circuit through the thermostat.

At 13 is shown a relay comprising the coil 14 which, when energized, will draw down the core 15 which, through stem 16, will pull down the contact plate 17 against the resistance of spring 18 until the spaced contacts 19 and 20 are bridged by plate 17. At the same time a second contact plate 21, also on stem 16, will bridge a second pair of contacts 22 and 23.

When the predetermined temperature in the space, for example 72° F. is reached a current will flow from the positive main 7 through wire 24, resistor 25, thermostat 9, wire 26, relay coil 14 and wire 27 to the negative main 8. When the coil 14 is energized, the contact plates 17 and 21 will be pulled down and a circuit will be completed from the positive main 7 through wire 28, relay contacts 19, 17 and 20, wire 29, motor C, and wire 30 to the negative main. This will start operation of the motor C and consequently of the compressor system. At the same time a circuit will be completed from wire 28 through relay contacts 22, 21 and 23, wire 31, valve 5, and wire 32 to the negative main. This will open the valve 5 and hold it open so that there will be a flow of refrigerant through the smaller evaporator section A′, as long as the temperature in the space controlled remains at or above 72° F.

If this 25% capacity evaporator is adequate to prevent further rise in the space temperature, the section A' (and the compressor motor C) will remain continuously in service until the space temperature has been lowered below 72° whereupon the several circuits will be broken and valve 5 will close and the refrigerating system will cease to operate. However, if the space temperature should continue to rise, for example to 73½°, a second thermostatic assembly will function to cause the second evaporator section A'' to operate.

A second thermostat 33, positioned in the same space or subject to the same temperature as the first thermostat 9, is adapted to function at an atmospheric temperature of (for example 76°. However, the mercury in this thermostat is surrounded by or subject to the temperature of an auxiliary electric heating coil 34 which, when energized, will raise the temperature at the thermostat 2½° so that the thermostat will actually function at an atmospheric temperature of 73½°. (It will be understood that the temperatures here named are taken merely by way of example.) Now if the evaporator section A', operating at full capacity, is unable to prevent the rise of the space temperature above 72°, when this space temperature reaches 73½° the mercury column 35 will contact the upper fixed contact 36.

At 37 is shown a relay (in many respects similar to the relay 13, already described) comprising a magnetic coil 38, a core 39, a retracting spring 40 adapted to lift the core when the coil is deenergized, a contact plate 41 adapted to engage the two fixed contacts 42 and 43 when the relay is energized, and a second contact plate 44 adapted to engage a second pair of contacts 45 and 46 when the relay is deenergized.

When relay 37 is deenergized, a current will flow from the positive main 7 through wire 47, heating coil 34, wire 48, resistor 49, relay contacts 45, 44 and 46, and wire 50 to the negative main 8. Consequently the heater 34 will be energized and will raise the temperature at thermostat 33 so that at an actual space temperature of 73½°, this thermostat will close the following circuit: From the positive main through wire 51, resistor 52, thermostat 33, wire 53, relay coil 38 and wire 54 to the negative main. The relay contacts will now be pulled down so that a circuit will be closed from positive main 7 through wire 55, valve 6, wire 56, relay contacts 42, 41 and 43 and wire 50 to the negative main. As a result the valve 6 will be opened and refrigerant will be permitted to flow from pipe 4 through valve 6 to the larger evaporator coil A''. However, the energizing circuit for auxiliary heater 34 will simultaneously be broken since the relay contact 44 will be pulled away from the contacts 45 and 46. Consequently the temperature affecting thermostat 33 will at once be lowered by 2½° (that is to approximately 73½°) whereas the effective temperature at this thermostat was formerly 76°. The mercury column at this thermostat will, therefore, at once begin to lower and break contact at the terminal 36, thus deenergizing the relay 37 and permitting the valve 6 to close. Consequently only a momentary burst of refrigerant will be admitted to the evaporator section A'', but the energizing circuit for heater 34 will immediately be closed again so that the effective temperature at thermostat 33 will again be raised to 76° or higher and the cycle of operations will again be repeated. This so called "cycling" thermostat will thus cause the valve 6 to be repeatedly opened and closed so as to intermittently admit refrigerant to the coil A''. As a result this coil A'' will only be partially effective to increase the cooling operation and augment the section A' which is still operating to its full capacity. If the temperature in the space should continue to rise, the valve 6 will be held open for a greater portion of the time and the effectiveness of the section A'' will be increased. If the temperature of the air flow should rise to 76°, the thermostat 33 will remain continually closed and relay 37 will be continuously energized so that valve 6 will remain open and the evaporator section A'' will be utilized to its full capacity.

As the temperature in the controlled space is gradually lowered, the above cycle of operations will be reversed. The effective capacity of the section A'' will be gradually cut down until the temperature is lowered below 73½°, whereupon the valve 6 will remain closed and section A'' will be ineffective. When the space temperature is lowered below 72° the valve 5 will be closed and the section A' will become ineffective. At the same time the motor C will be stopped and the entire refrigerating system will be put out of service.

While the thermostat 9 has been described as functioning at an atmospheric temperature of 72°, and the thermostat 33 at an atmospheric temperature of 73½°, it is to be understood that these temperatures are merely illustrative and chosen by way of example. Means may be provided for adjusting the operating temperatures of these thermostats. A manually operable rheostat is shown at R. By adjusting the movable contact 57 of this rheostat along the resistance coil 58, the strength of a heating current may be adjusted which flows as follows: From positive main 7 through wire 47, heating coil 34, wires 48, 59 and 60 to and through rheostat contact 57, the selected portion of resistance 58, and wire 61 to the negative main. At the same time a similar shunt heating circuit is completed from the positive main through wire 62 to and through a heating coil 63 associated with the thermostat 9, and thence through wire 60 through rheostat R to the negative main. These heating currents are constantly flowing through each of the coils 63 and 34 and by suitably adjusting the rheostat R the functioning temperatures of the two thermostats 9 and 33 can be simultaneously adjusted without affecting the difference between these operating temperatures. It may be noted that a portion of the "cycling current" for heater 34 may also flow through the heater 63 on thermostat 9, but this cycling current will only be made and broken at such times as the thermostat 9 is continuously closed so that the consequent variations in the temperature at this thermostat 9 will be of no consequence.

We claim:

1. In a cooling system, means for supplying and circulating a refrigerant comprising a compressor interposed in the refrigerant circuit, a motor for driving the compressor, an evaporator comprising a plurality of separate sections arranged in parallel in the refrigerant circuit, a pair of thermostatically controlled means responsive to temperature changes in the space cooled by the system, one of these means directing the continuous flow of refrigerant to one of the sections as long as the temperature is at or above a predetermined temperature and the other means also causing at least an intermittent flow of the

refrigerant to a second section while the temperature is above another higher temperature, this flow to the second section becoming continuous at or above this predetermined maximum temperature.

2. In a cooling system, means for supplying and circulating a refrigerant comprising a compressor interposed in the refrigerant circuit, a motor for driving the compressor, an evaporator comprising a plurality of separate sections arranged in parallel in the refrigerant circuit, a pair of thermostatically controlled means responsive to temperature changes in the space cooled by the system, one of these means starting the refrigerant supply means and directing the continuous flow of refrigerant to one of the sections as long as the temperature is at or above a predetermined temperature, and the other means also causing at least an intermittent flow of the refrigerant to a second section while the temperature is at or above another higher temperature, this flow to the second section becoming continuous at or above a predetermined maximum temperature.

3. In a cooling system, means for supplying and circulating a refrigerant comprising a compressor interposed in the refrigerant circuit, a motor for driving the compressor, an evaporator comprising a plurality of separate sections arranged in parallel in the refrigerant circuit, a pair of thermostatically controlled means responsive to temperature changes in the space cooled by the system, one of these means directing the continuous flow of refrigerant to one of the sections as long as the temperature is at or above a predetermined temperature and the other means also causing at least an intermittent flow of the refrigerant to a second section while the temperature is at or above another higher temperature, this flow to the second section becoming continuous at or above a predetermined maximum temperature, and means for simultaneously raising or lowering the predetermined temperatures by equal amounts.

4. In a cooling system, means for supplying and circulating a refrigerant comprising a compressor interposed in the refrigerant circuit, a motor for driving the compressor, an evaporator comprising a pair of separate sections arranged in parallel in the refrigerant circuit, a valve for controlling the flow of refrigerant to each section, means comprising a thermostat functioning at a predetermined temperature to start the motor and open one valve to cause the continuous flow of refrigerant to one section so long as the temperature in the controlled space is at or above a predetermined temperature, means comprising a second thermostat for intermittently opening and closing the other valve to provide at least a cycling flow of refrigerant to the second section while the temperature in the space is at or above a second predetermined higher temperature, the flow to this second section becoming continuous at or above a predetermined maximum space temperature.

5. In a cooling system, means for supplying and circulating a refrigerant comprising a compressor interposed in the refrigerant circuit, a motor for driving the compressor, an evaporator comprising a pair of separate sections arranged in parallel in the refrigerant circuit, a valve for controlling the flow of refrigerant to each section, means comprising a thermostat functioning at a predetermined temperature to start the motor and open one valve to cause the continuous flow of refrigerant to one section so long as the temperature in the controlled space is at or above a predetermined temperature, means comprising a second thermostat for intermittently opening and closing the other valve to provide at least a cycling flow of refrigerant to the second section while the temperature in the space is at or above a second predetermined higher temperature, the flow to this second section becoming continuous at or above a predetermined maximum space temperature, and means for simultaneously raising or lowering these predetermined temperatures by equal amounts.

6. In a cooling system, means for supplying and circulating a refrigerant comprising a compressor interposed in the refrigerant circuit, a motor for driving the compressor, an evaporator comprising a pair of separate sections of different effective sizes, arranged in parallel in the refrigerant circuit, means comprising a valve at the inlet of the smaller section and a thermostat responsive to temperature changes in the space cooled by the system for starting the motor and holding the valve open while the space temperature rises to or exceeds a predetermined temperature, means comprising a second valve at the inlet of the larger section, a second space-temperature responsive thermostat, and auxiliary heating means acting on said second thermostat for causing an intermittent flow of refrigerant to the larger section in accordance with the rise in the space temperature above a second predetermined higher temperature, the second section being used to full capacity when the temperature reaches a predetermined maximum.

TIMOTHY J. LEHANE.
EVERETT H. BURGESS.