May 3, 1932. F. F. VON WILMOWSKY 1,856,797

APPARATUS FOR HEATING, COOLING, AND REGULATING THE TEMPERATURE OF BUILDINGS

Filed June 28, 1924 3 Sheets-Sheet 1

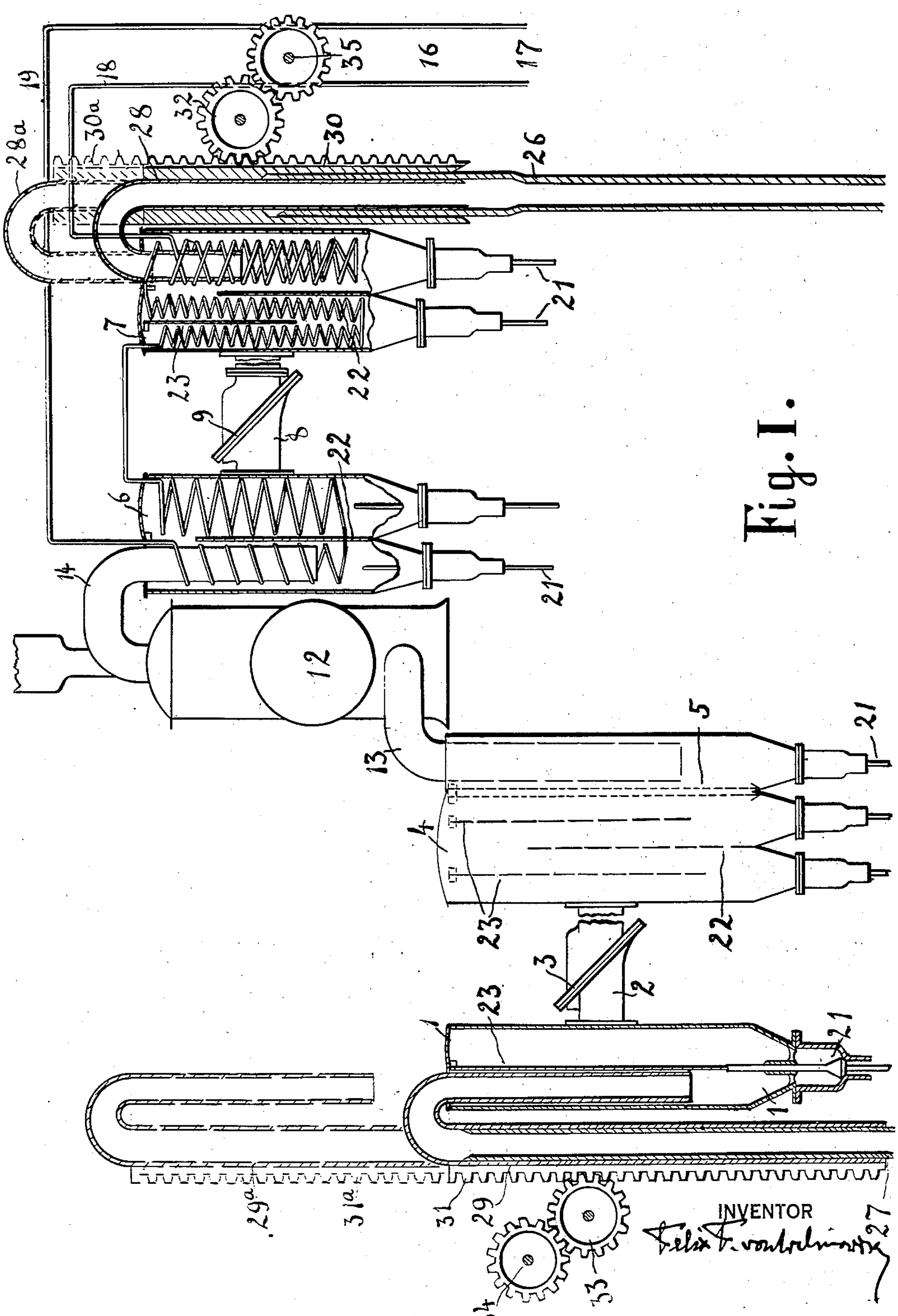

Fig. I.

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APPARATUS FOR HEATING, COOLING, AND REGULATING
THE TEMPERATURE OF BUILDINGS

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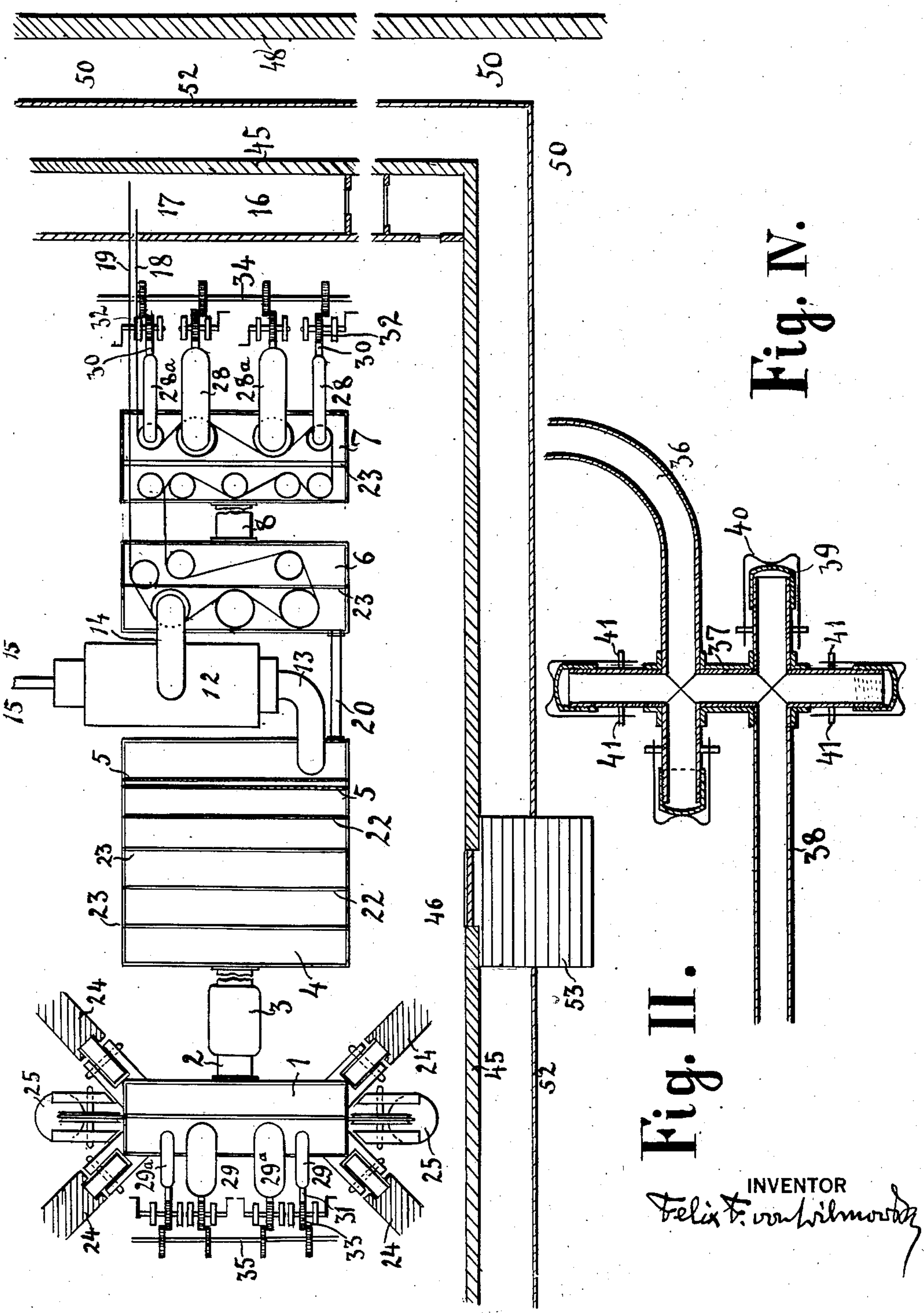

Fig. II.

Fig. IV.

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Felix F. von Wilmowsky

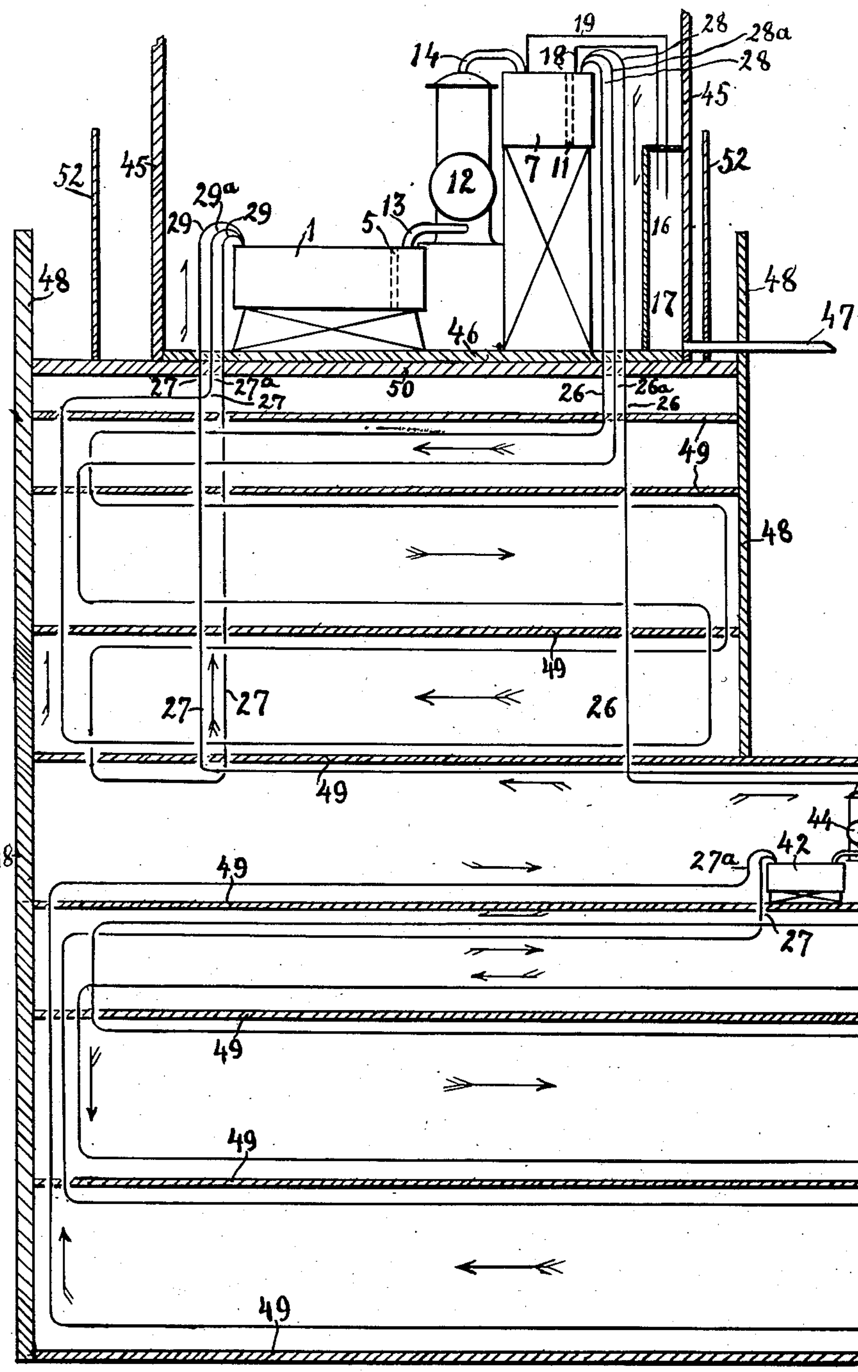


Fig. III.

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# UNITED STATES PATENT OFFICE

FELIX F. VON WILMOWSKY, OF NEW YORK, N. Y.

## APPARATUS FOR HEATING, COOLING, AND REGULATING THE TEMPERATURE OF BUILDINGS

Application filed June 28, 1924. Serial No. 723,060.

The invention for which a patent application was informally filed in the United States Patent Office first on June 23, 1923, relates to the heating and cooling of entire buildings and housing suites or rows as well as of single apartments or rooms and other enclosed spaces and containers, and to the raising and lowering of the temperature of their interior as well as to the automatic maintenance of an even temperature within the same; further, to apparatus serviceable in the said art. It relates more especially to the indirect method of raising and lowering the temperature of houses and enclosed spaces by means of passing a liquid such as water or a suitable brine which has been heated by some heating agent such as superheated steam or been chilled by some refrigerant such as expanding cold compressed ammonia gas, through a closed line of piping, the travelling liquid parting with its higher or lower temperature through the heat-conducting walls of the pipes while these are in contact either with the fluid contents of the interior or with the heat-conducting covering of the floor or the ceiling, or lining of the walls, of the enclosed spaces to be heated or cooled the travelling liquid then flowing back to its starting point and being anew charged with or deprived of heat and thereafter being started anew on its course. Such a system of cooling, as heretofore installed, with the refrigerating apparatus located in the basement or on the ground floor of the building to be cooled, has been used little if at all for houses where people congregate or live such as dwellings, hospitals, schools, offices, because it becomes too dangerous to life in the case of an accidental escape of the gaseous refrigerants, all of which are either explosive or noxious or poisonous, as long as a highly compressed refrigerating gas is introduced inside of the housing structure so that it may spread in the interior. From the economic point of view the indirect system of both cooling and heating by means of a hot and, respectively, a cold liquid with forced movement, as heretofore used, has been found unreasonably expensive for higher buildings on account of the steady consumption of a substantial amount of power by the pumps or other means lifting the travelling liquid up from the ground at every cycle and too troublesome because of the frequent clogging of the pipes in a closed circuit. The object of the invention herein specified is to eliminate the interruptions and to restrict the steady consumption of power for pumping and to make the plant run continuously without skilled labor and in substance automatically. The invention has for its object in particular the elimination of the danger to life which is involved in the circulating of a compressed explosive or noxious or poisonous gas such as ammonia, dioxide of carbon or of sulphur, hydrocarbon oil gases, inside of the buildings or enclosed spaces to be cooled, or on a level with the ground, whence the gas is liable to spread into the interior.

I have eliminated the danger to life involved in the present use of the indirect system by putting the plant in which the liquid is refrigerated or heated, if a dangerous compressed and circulating gas such as ammonia is used for the refrigerating, self-contained in an isolated or literally gastight enclosed special chamber or outhouse, bowl-like, with a gastight foundation, and by locating the plant outside on top or preferably upon the roof of the building or enclosed space to be heated or cooled, so that in any case the escaping gas can reach either the open ground or the interior of the enclosed space only after lengthy diffusion through the free air. If the refrigerant gas is substantially heavier than the air, as carbon dioxide and the hydrocarbon oils are, I connect with the bowl-like enclosure surrounding the refrigerating plant a chute provided with a coarse grating which conducts the gas that escapes by accident diluted with air away from the building. This arrangement makes it possible to overcome the economically most serious defect of the indirect system of heating and cooling houses by means of a travelling liquid, as heretofore used, by relying, for the movement of the cooling or heating liquid through the pipe line, on the natural law of gravity as applying to liquids, viz., that liquids seek their level; the velocity of the flow of the liquid is regulated by the difference of the levels of the starting point of the closed pipe line in the roof-house and of the terminal point of the line, likewise in the roof-house, or the difference between the level at which the liquid under atmospheric pressure flows into the closed pipe line and the level at which it becomes again exposed to the direct atmospheric pressure at the return end of the pipe line. Only this difference requires to be spanned by some pumping or lifting force, since the pipes are given a width too great for much capillary action; and the break in the circulation affords the opportunity for regularly cleansing and filtering the travelling liquid. Where local conditions justify the running expenditure of the power required for lifting the liquid to a greater extent, I can make the liquid leave the line at the same level as or even at a level higher than the inflow level by exerting some pressure upon the liquid at the inflow point of the line in addition to the atmospheric pressure—this may be done by utilizing the steam pressure of the heated liquid—or by applying, through some auxiliary mechanism, suction preferably at the exit of the line. I prefer this latter method for chilled liquids.

The farther the level of the returning liquid as exposed to the atmospheric pressure in the return tank or in the free nozzle of the pipe line is below the level of the inflowing liquid likewise as exposed to the atmospheric pressure, the quicker is the flow in the pipe line; even a local elevation of the closed line above the level of the inflow amounting for cold water to no more than, at the utmost, approximately 30 feet in a wide pipe does not stop the flow in the line as long as the level of the returning liquid is well below the level of the inflowing liquid. As liquids generally expand and become lighter when their temperature is raised, the cold liquid driving during its descent warmed liquid before it expedites the flow, and for maintaining in the line an efficiently rapid current without artificial pressure or suction the difference between the two levels need not be made as great as it would have to be if the liquid were not chilled; on the other hand, if the liquid is hot, the difference of the two levels under atmospheric pressure must be greater and more pumping power is required, since the cooled liquid has to be lifted by the hot and lighter liquid succceeding it in the closed line. As long as the mouths or inlets, where the travelling liquid is paid into the pipe lines under atmospheric pressure, and the nozzles or outlets, where the liquid is received back from the lines, are on one and the same level, no flow takes place, if the liquid entering the lines is hot; and only a feeble flow, if the liquid is cold. The objectionable clogging of the pipes I have eliminated by using only quite pure liquids and by breaking the cycle of the flow and introducing into it the renewed purification of the travelling liquid, which is of particular importance for the heating liquid, and by giving to the pipes a uniform width as far as practicable throughout each line and a standard radius of curvature so that the inside of the pipe can be scraped and scrubbed readily, and by making the same easily accessible.

The annexed drawings illustrate the manner in which I use my inventions preferably; I do not, however, limit myself to the devices there shown, the invention being capable of use in various forms. In the annexed drawings,

Figure I is a diagram, in part a section, of the lateral elevation of an installation consising of a cooling plant and a heating plant showing the general arrangement inside of a roof-house; the two sets of vessels, pump and tanks lying one behind the other from the lateral point of view, only one of the two sets is shown.

Figure II is a diagram, partly a section, of the plan of a combined cooling and heating plant, in which the same vessels or tanks are used at one time for heating and at another time for cooling the interior of the building below the plant; the covers of the vessels and tanks are left off.

Figure III is a diagram, partly a section, of the lateral elevation of a combined heating and cooling system as installed upon the roof and inside of a seven-story building, with an auxiliary installation on the third floor.

Figure IV shows the section of a composite joint formed by the terminals of two reaches of piping crossed by an intermediary piece of piping, with one of the pipe reaches curved.

Similar numerals refer to similar parts throughout the several drawings, where separate lines of piping, one for cooling and one for heating, are shown, the letter *a*, added to the numeral, denotes the heating lines.

With the exception that for heating a hot liquid is used, which requires a heater, and for cooling a chilled liquid, which requires a refrigerator, the system is substantially the same whether used for heating or for cooling, and the same tanks or vessels can be employed in winter for heating the building and in summer for cooling it. The same pipe line can be employed for circulating the heating liquid in winter and the cooling liquid in summer; I much prefer, however, to use separate pipe lines for the heating liquid and for the cooling liquid; the heating line running near the floor and the cooling line running near the ceiling of the compartments whose temperature is to be regulated. Besides the heating or refrigerating agent for the liquid—as such I prefer a gas or vapour passing through coiled piping in the heating and respectively the refrigerating tank—the new method when applied involves in its simplest form, where the heating or cooling liquid is circulated through the building below under atmospheric pressure, in accordance with the principle of the siphon, two tanks or vessels communicating with each other through a pipe line, one of the vessels being at a higher level than the other; the liquid passes from the higher vessel to the lower vessel through the pipe line with the constant tendency to reach again the higher level; a pump serves to lift the liquid from the level of the lower vessel to the level of the higher vessel.

The three installations shown in the Figures I, II and III illustrate the system, with some variation of the detail. The installation shown in Figure I consists of two separate plants or systems of tanks, one for heating and the other for cooling; both plants have the same dimensions; only the cooling plant, which is in front as the installation is viewed, is shown in its detail; the heating plant, in the rear of the cooling plant, is shown only in so far as it is not hidden behind some part of the cooling plant. The covered rectangular tank 1, shown in section and marked 1, receives the liquid to be circulated; the latter, if a brine or other mixture, can be prepared afresh in the tank 1. The liquid flows from tank 1 through a tube marked 2 and a check valve marked 3—both are shown in outline, the tube broken off—and connected into another covered rectangular tank shown in outline and marked 4. The tank 4 is on the same low level as the tank 1; it is divided into two compartments by a double diaphragm filter, which is indicated by broken lines and is marked 5. The liquid, cleansed after passing through the filter 5, is lifted from the second compartment of the tank 4 by a low-power pump, which is shown in outline and is marked 12, through the feed-pipe marked 13 (its lower part is indicated by a broken line). The delivery pipe, marked 14, of the pump 12 delivers the liquid on the higher level into the covered rectangular chilling tank, which is shown partly in section and partly in outline and is marked 6. In this tank 6 the liquid comes into contact with a system of coiled pipe, shown in outline and marked 18—19; through the coils, which form a closed pipe line, passes the expanding refrigerant gas, which comes in the pipe line from the gas compressor at the site marked 16′. The compressor itself is not shown, since it can be of any design that is now in use, such as the apparatus producing compressed carbon dioxide or liquefied ammonia or dioxide of sulphur. The liquid, chilled, flows through a tube, which is shown in outline and is marked 8, and through the check valve marked 9 into a further covered rectangular tank, which is shown partly in section and partly in outline and is marked 7; the tank 7 is on the same high level as the tank 6. The liquid comes there into contact with further coils of the closed pipe line 18—19, the refrigerant gas after leaving the compressor passing first through the tank 7 and then through the tank 6 and from tank 6 returning to the compressor. Through an opening, which can be closed and can also be made airtight, in the cover of the tank 7 passes one of the vertical legs of a double-bent tube, which is shown in section and is marked 28; the leg reaches halfway down in the tank 7; the other leg of the tube 28 fits, closely telescoping, into a suitably widened vertical reach of pipe, which is shown in section and is marked 26. This vertical reach of pipe 26 and the other vertical reach of pipe shown in the Figure I and which is marked 27 and is likewise connected with it shown in section, are the beginning and the end of the cooling pipe line through which the tank 1 and the tank 7 communicate. Fitted around the vertical reach of pipe 27 and closely telescoping with it is one of the vertical legs of another double-bent tube, which is shown in section and is marked 29; the other vertical leg of the tube 29 passes through a close-fitting opening—which can be closed and can also be made to fit air-tight around the tube 29—in the cover of the tank 1 and reaches half-way down into the first compartment of tank 1. The double-bent tubes 28 and 29 thus form the head-pieces of the pipe lines 26—27, the headpiece 28 reaching halfway down into the tank 7 on the high level and the headpiece 29 reaching halfway down into the tank 1 on the low level. The chilled liquid in tank 7 rising above the mouth of the headpiece 28 enters the latter and rises in it while the tank 7 is filling. When the tank 7 is filled with the liquid, its cover is closed airtight and the tube 28 is made to fit airtight into the cover; pressure is then applied to the liquid by some suitable means, say, by pumping air into the tank 7; the liquid under the pressure rises in the headpiece 28 until it reaches the bend, from which it falls down into the pipe 26; the small amount of air which at first remains at the highest point of the bend in the headpiece 28, is soon sucked down into the pipe 26 by the falling liquid; when the headpiece 28 is substantially free of air, the artificial pressure is removed from the tank 7, which at that time should still be more than half full; further liquid is thus admitted through the check valve 9 from the filled tank 6 under atmospheric pressure. My preferred means of starting the flow in the pipe line is suction applied through the exit terminal of the pipe line. The chilled liquid after entering the pipe 26 passes through the pipe line, filling it, until it reaches the terminal reach 27 and passes through the headpiece 29 into the first compartment of the tank 1. The flow of the cooling liquid through the pipe line 26—27 continues indefinitely under atmospheric pressure as long as the pump 12 lifts the liquid from the lower level of the tank 1 to the higher level of the tank 7. The tanks 4, 6 and 7 have alternate upright partitions, the ones reaching half-way or three-quarters up from the bottom and marked 22; the others reaching half-way or three-quarters down from top-bars, to which they are attached; they are marked 23, 23. The upright partitions 22, 22 and 23, 23 and shown in section in the tanks 1, 6 and 7 and indicated by broken lines in the tank 4, serve to impart to the passing liquid a circuitous route and thus to make it give up such scum and sediment as may develop in it. The bottoms of the tanks are funnel-shaped between the several upright partitions 22, 22; the throats of these funnels are closed by check valves, which are marked 21; at the base of the tank 1 such a valve 21 is shown in section. The valves 21, 21 can be raised by their stems; that way the accumulated sediment, and also the entire liquid, can be removed from the tanks. Each headpiece, 28 and 29, has a rack along its vertical leg which telescopes with the pipe line; the racks are marked, respectively, 30 and 31. Each rack is in mesh with a toothed wheel, marked, respectively, 32 and 33. Each of these toothed wheels 32 and 33 is in further mesh with another toothed wheel; the axles of the latter are marked, respectively, 35 and 34. By turning the axle 35, the headpiece 28 is moved vertically up and down, gliding inside of the extremity of the pipe reach 26, with which it telescopes and to which it is closely fitted; room for the pipe 26 being left between the tube 28 and its rack 30 as well as its jacket (shown in section). The mouth of the entrance headpiece 28 can thus be adjusted to the level of the liquid in the tank 7; the headpiece 28 can also be raised entirely out of the tank 7; this is done when the plant is put out of commission. By raising the mouth of the headpiece 28 above the surface of the liquid in the tank 7 the flow in the pipe line 26—27 is stopped. The pipe line is emptied entirely of its liquid by opening a tap at the lowest point of the line. The raised position of the entrance headpiece is shown in the corresponding headpiece of the heating plant in the rear of the cooling plant; the entrance headpiece of the heating plant, shown in section, is raised to its full height and is marked 28*a*. In likewise, the exit headpiece 29 is raised by turning the wheel axle 34; the exit headpiece of the heating plant, out of commission, is shown in broken lines in its raised position in the rear of the headpiece 29; it is marked 29*a*. These two headpieces 28*a* and 29*a* and the site of the steam generator marked 17*a* are the only parts of the heating plant in the rear of the cooling plant which are shown.

In Figure II a combined plant is shown, where the same tanks, all of them rectangular, serve at one time for a cooling liquid and at another time for a heating liquid; in this installation, there are separate pipe lines for heating the building below the plant and for cooling it. While the plant is employed for cooling, the headpieces 28*a* and 29*a* of the heating pipe line are in their raised position, out of touch with the tanks and out of commission; when the plant is to be put out of commission for cooling and it is to be used for heating, the refrigerant is shut off and the pipe line is disconnected; the headpieces 28 and 29 are given their raised positions, the tanks are drained by lifting the check valves in their bottoms, the pipe line is drained through the tap at its lowest point, and the tanks and the pipe lines are cleansed; the coiled pipe line is then connected with the steam generator, the tank 1 receives the heating liquid, and the headpieces 28*a* and 29*a* assume their lowered positions such as are shown in Figure I by the headpieces 28 and 29. The rectangular tanks 6 and 7 in Figure II are shown in outline and uncovered, with upright half-way partitions 22, 22 and 23, 23; and, in tank 4, a double diaphragm filter 5. The tanks 4, 6 and 7 are shown on fixed platforms, as they are in Figure I. The rectangular tank 1, shown uncovered and as viewed from above, is suspended on two counterweights, which are marked 25, 25; the latter are adjustable so that the tank can more readily be raised and lowered by suitable means such as hydraulic pressure, whether it is empty or filled. The tank 1 has at its four corners flanges which bear projecting wheels; the latter fit into grooves in the pillars at the four corners of the tank 1; these pillars are shown in section and are marked 24, 24. The tube 2 in Figure II is shown broken off between the check valve 3 and the wall of the tank 4; in that reach (not shown), is a flexible piece of tubing intercalated, which accommodates the varying distance between the check valve 3 and the tank 4. An overflow pipe is between tank 6 and tank 4; it is marked 20. The pump 12 is driven by a motor, not marked; the site of the motor is marked 15. The serpentine windings of the coiled tubing in the rectangular tanks 6 and 7, through which at one time the heating vapour passes and at another time the refrigerant gas, are indicated in Figure II by single lines; the tubing is connected with the gas compressor when the liquid is to be chilled; it is connected with the steam generator for heating the liquid. The sites of the gas compressor, 16, and of the steam generator, 17, in Figure II are located in a chamber separated from the tank-room by walls, which are shown in section. The walls of the roof house containing the plant are likewise shown in section; they are marked 45. All around the roof house a closed gasproof wall or fence is shown in section, marked 52; it shuts the lower part of the roof house with its plant entirely off from the remainder of the roof and from the building below it. A double stoop leading over the fence 52 and giving access to the floor, marked 46, of the roof house is shown as viewed from above; it is marked 53.

In Figure III, a building is shown in section which is heated in winter and cooled in summer by the apparatus herein above described, with its walls marked 48, 48, the floors of its seven stories and of its attic marked 49, 49, and its roof marked 50. The roof house contains a combined heating and cooling plant; it is likewise shown in section, with its walls 45, 45; its gasproof surrounding wall 52, and its separate chamber for the gas compressor and the steam generator with their sites marked 16 and 17; from this chamber a chute shown in outline and marked 47 serves to carry escaping gas or vapour away from the building. Two rectangular tanks are shown: a receiving and inflow tank 1 at a low level and a chilling and outflow tank 7 at a high level; each tank rests on a fixed platform. The tank 1 in this plant is divided into two compartments by the double diaphragm filter marked 11; the pump 12 draws the cleansed liquid from the second compartment of the tank 1. Another double diaphragm filter, marked likewise 11, is shown, dividing the tank 7 into two compartments; the refrigerant gas, at one time, and at another time the heating steam, in the coiled tubing marked 18—19, passes from the separate chamber first through the second compartment of the tank 7 and then through the first compartment of the same tank and back to the gas compressor or the steam generator. The direction of the flow in the several pipe lines has been indicated by means of arrows; the several groups of double-bent headpieces, which are actually one behind the other as viewed from the side, are shown in Figure III side by side or one above the other, for the sake of greater clearness. The plant on the roof 50 serves directly only the upper three stories and the attic of the building; in a chamber on the fourth floor an auxiliary heating and cooling plant is shown installed, which serves the four lower floors of the building. This auxiliary plant is made up of a rectangular outflow tank shown in outline and marked 43, fixed and on a high level; a rectangular inflow tank, shown in outline and marked 42 and fixed on a low level; and, between the two tanks, a low-power pump shown in outline and marked 44. In this auxiliary plant a special pipe line, in all essential parts like the line marked 26—27 in Figure I and also here marked 26—27, indicated by a single line, with headpieces like those shown in Figure I and there marked 28 and 29, descends straight from the roof tank 7 into the auxiliary outflow tank 43; it forms in the tank a lengthy system of coils and windings and goes back from the tank 43 to the inflow tank 1 on the roof. The liquid in the auxiliary outflow tank 43 is thus chilled at one time, and at another time is heated, by means of the liquid of the roof tank 7 passing through the special pipe line. The flow of the liquid through the pipe line serving the four lower stories of the building is under atmospheric pressure.

Each of the tanks of the plant has a level-indicator and a thermometer (not shown in the drawings). Each one of the pipe lines as well as the special pipe line of the auxiliary plant shown in Figure III has a uniform width of cylindrical core throughout its length as far as practicable, sufficiently large for assuring an expeditious flow of the liquid and substantial absence of capillary effects. Where curves are necessary in the pipe lines, an arc of suitable standard radius is employed; at such points I either have the terminals of two straight reaches of piping cross each other or I terminate the piping beyond the curve and connect the terminal with the subsequent straight reach of the pipe line through a short interpolated straight piece. The composite form of joint here described is shown in Figure IV; there, the curved terminal of the pipe is marked 36; the interpolated straight piece of pipe, 37; and the straight reach of pipe through which the line is continued, 38. The terminals of the several reaches of piping are closed by double caps fitting the size of the piping, the inner and strong cap, marked 39 in Figure IV, being screwed upon the end of the pipe and being sufficiently strong to withstand the pressure of the column of liquid above it; the outer cap, marked 40 in Figure IV, which bears with elastic force against the inner cap, is fixed upon the pipe with a sideways-turning or bayonet-locking device; it serves to prevent accidental unscrewing of the inner cap. The terminals can be opened readily by means of the plugs marked 41 serving as fulcrums for a lever whenever the pipes are to be cleansed. At suitable points of the several pipe lines stop-cocks and short-cuts and taps are provided; where a number of apartments or rooms are served by one and the same unit pipe line, some of the rooms or apartments can thus be eliminated and the circuit temporarily be shortened.

Where a uniform, high or low, temperature is to be maintained in the interior automatically, I connect a thermostat or thermostats, which are located at suitable places in the interior, either with stop-cocks and short-cuts at suitable places in the line, which serve to reduce or stop the flow of the liquid in that line or reach, or with the mechanism controlling the level of the respective return nozzle: by increasing the difference between the level of the free return nozzle and the level of the liquid in the inflow vessel 7 the flow in the line is quickened, by decreasing the difference the flow is deadened; the flow stops when the difference approaches zero.

Wherever the hot or cold liquid is not to give off or carry away heat, its container is surrounded by a non-conducting jacket; in the annexed drawings the jackets are not shown. As an adiathermic for the cold liquid a light substance is preferably used, such as ground cork or felted peat fibre; for the containers of the hot liquid, some non-combustible material, such as slag-wool or magnesia packing. For the tanks and vessels, the piping and the tubes and telescoping terminals some metal is used which is either enamelled inside or is indifferent to the liquid as aluminium is to some brines or as stainless steel is.

I claim:

1. In a plant for heating or cooling or regulating the temperature of the interior of houses and other enclosed spaces and containers, the combination of two containers for a fluid which are located above the level of such interior; and of temperature-imparting apparatus likewise located above the level of the said interior and by means of which a temperature suitable for the exchange of heat with the interior can be imparted to such fluid; and of a line of piping which runs below the containers and through which the containers communicate and the fluid, while at a temperature as aforesaid, can pass from one container down to the said interior, exchange heat with the interior, and then rise up into the other container.

2. In a plant for heating or cooling or regulating the temperature of the interior of houses and other enclosed spaces and containers, the combination of two containers for a liquid, which are located above the level of such interior; and of temperature-imparting apparatus likewise located above the level of the said interior and by means of which a temperature suitable for the exchange of heat with the said interior can be imparted to such liquid; and of a line of piping which runs below the containers and through which the containers communicate and the liquid, while at a temperature as aforesaid, can flow from one container down to the said interior, exchange heat with the interior and then rise up into the other container; and of a pressure-producing device by means of which the liquid can be made to pass, while above the level of the interior, from the second container back into the first-said container.

3. In a plant for heating or cooling or regulating the temperature of the interior of houses and other enclosed spaces and containers, the combination of two containers for a liquid, which are located above the level of such interior and which are at different levels in relation to each other; and of temperature-imparting apparatus likewise located above the level of the said interior and by means of which a temperature suitable for the exchanging of heat with the said interior can be imparted to such liquid; and of a line of piping which runs below the containers and to the said interior and through which the containers communicate and the liquid, while at a temperature as aforesaid, can pass from the high-level container down to the said interior, exchange heat with the interior, and then rise up into the low-level container; and of apparatus by which the liquid can be raised from the low-level container to the high-level container.

4. In a plant for heating or cooling or regulating the temperature of the interior of houses and other enclosed spaces and containers, the combination of two containers for a fluid, which are located above the level of such interior; and of temperature-imparting apparatus, likewise located above the level of the said interior and which can impart to such fluid a temperature suitable for the exchanging of heat with the interior; and of a line of piping which runs below the containers and to the interior and through which the containers communicate and the fluid, while at a temperature as aforesaid, can pass from one of the containers down to the said interior, exchange heat with the interior, and then pass up into the other container; and of apparatus by which the fluid can be cleansed while on its circuit before it passes into the pipe line.

5. In a plant for heating or cooling or regulating the temperature of the interior of houses and other enclosed spaces and containers, the combination of two containers for a liquid, which are located above the level of such interior; and of temperature-imparting apparatus likewise located above the level of the interior and which can impart to such liquid a temperature suitable for the exchanging of heat with the interior; and of a line of piping through which the containers communicate and which runs below the containers and to the said interior and through which the liquid can pass from one container down to the said interior, exchange heat with the interior, and then rise up into the other container; and of a load-lifting mechanism by means of which the level of the liquid in one of the containers can be raised and lowered, thereby changing the levels of the two containers in relation to each other.

6. In a plant for heating or cooling or regulating the temperature of the interior of houses and other enclosed spaces and containers, the combination of two containers for a fluid, which are located above the level of such interior; and of temperature-impart-

ing apparatus likewise located above the level of the interior and by means of which a temperature suitable for the exchanging of heat with the interior can be imparted to such fluid; and of a line of piping through which the two containers communicate and which runs below the two containers and to a third container for a fluid, which is located below the first-said two containers and through which the first said fluid can flow from one of the first-said two containers down to the said third container, exchange heat with the fluid contents of the said third container, and then rise up into the other one of the first-said two containers; and of two containers for a fluid—one of these being the aforesaid third container—which are located below the first-said two containers; and of another line of piping, which runs from the aforesaid third container to an interior whose temperature is to be regulated, and then to the said fourth container and through which the second-mentioned fluid, while at a temperature suitable for the exchanging of heat with the last-said interior, can pass from the aforesaid third container to such interior, exchange heat with the interior, and then pass into the said fourth container.

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