

Aug. 12, 1947.

E. S. H. BAARS

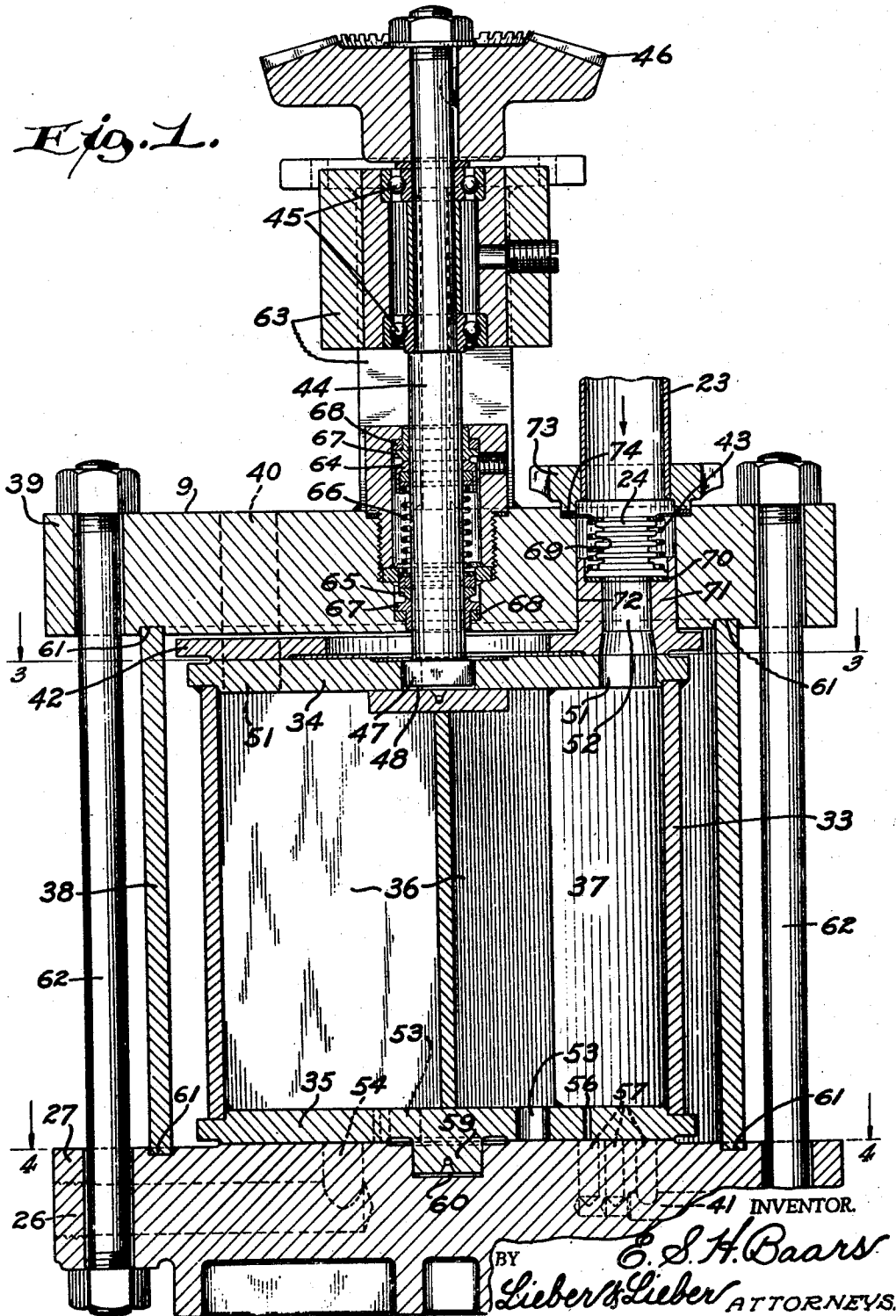
2,425,452

DISTRIBUTOR FOR REFRIGERATION SYSTEMS

Filed March 13, 1943

3 Sheets-Sheet 1

Fig. 1.



Aug. 12, 1947.

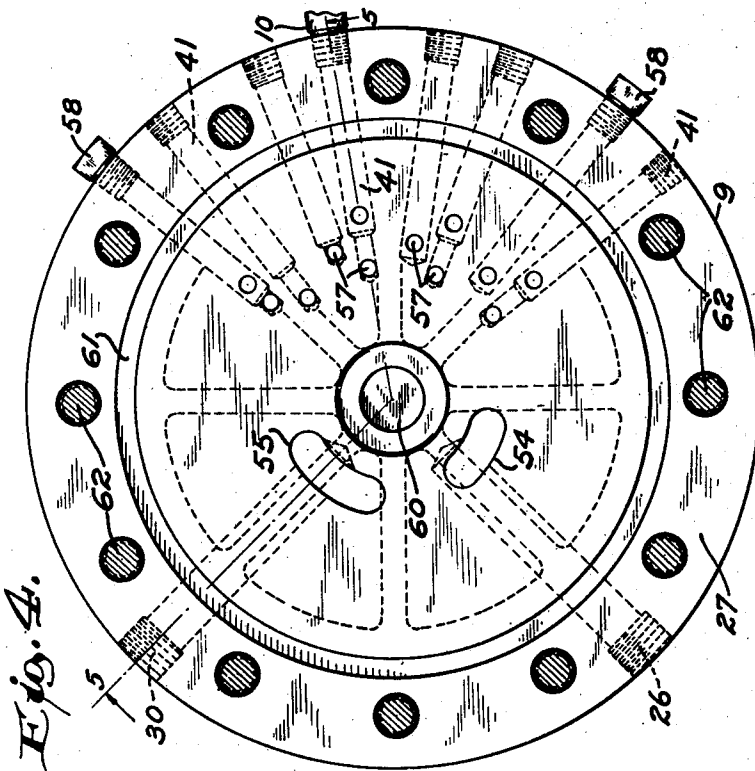
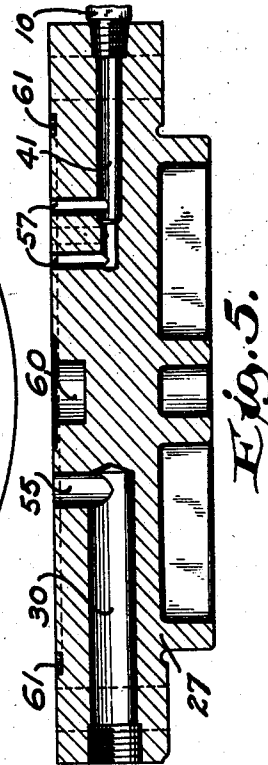
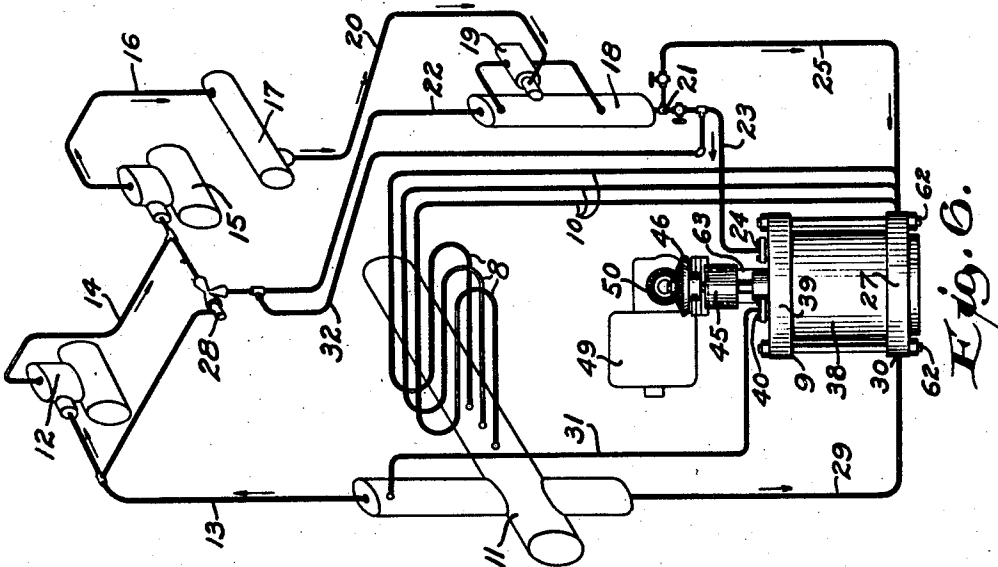
E. S. H. BAARS

2,425,452

DISTRIBUTOR FOR REFRIGERATION SYSTEMS

Filed March 13, 1943

3 Sheets-Sheet 3



INVENTOR.
E. S. H. Baars
BY *Lieber & Lieber*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,425,452

DISTRIBUTOR FOR REFRIGERATION
SYSTEMSErnst S. H. Baars, Milwaukee, Wis., assignor to
The Vilter Manufacturing Co., Milwaukee, Wis.,
a corporation of Wisconsin

Application March 13, 1943, Serial No. 479,029

8 Claims. (Cl. 62—3)

1

My present invention relates generally to improvements pertaining to the art of refrigeration, and relates more especially to an improved refrigerating system and to new and useful mechanism for feeding refrigerant to such systems.

The primary object of my invention is to provide an improved low temperature refrigeration system having simple and highly efficient feed mechanism for positively delivering an ample supply of refrigerant to such improved system.

Perhaps the most difficult and annoying problem in connection with the operation of low temperature refrigeration systems, is the matter of feeding fresh refrigerant to the cooling coils or other cooling elements, especially when the system involves a multiplicity of such coils or elements. Most of the prior feed mechanisms are thermostatically actuated and as a rule, such actuation is not sufficiently reliable and sensitive to insure requisite uniformity and abundance of feed for low temperature freezing. To my knowledge, none of the feed assemblages heretofore used in conjunction with low temperature refrigerating systems, are positive in action, and practically all of the prior mechanical feed mechanisms and feed pumps for other systems are relatively complicated and require considerable power for normal operation.

It is therefore a more specific object of the present improvement to provide an improved positive feed for delivering refrigerant to low temperature refrigeration systems, which is accurate and sensitive in operation and which is also operable without excessive power consumption.

Another specific object of this invention is to provide a simple and dependable feeder for high pressure refrigerant, wherein the existing high pressure is utilized to deliver the fluent refrigerant to the cooling coils, thereby avoiding necessity of mechanical propulsion with the aid of pumps or the like.

A further specific object of the invention is to provide an improved mechanical feed mechanism for high pressure refrigerant, which is operable with negligible power consumption to positively and effectively feed any desired number of cooling units or coils, and to meet varying feed requirements.

Still another specific object of my invention is to provide a new and useful low temperature refrigeration system having an improved refrigerant recirculating feature whereby contact of liquid refrigerant with all portions of the cooling surfaces is assured at all times.

2

An additional specific object of my present invention is to provide an improved low temperature refrigerating system provided with constant differential pressure control means for maintaining a definite pressure differential between the low pressure side of the cooling elements and the discharge side of the low pressure compressor, and which means may be regulated to meet varying conditions of operation.

These and other specific objects and advantages of the invention will be apparent from the following detailed description.

A clear conception of the several features constituting my present improvement, and of the mode of constructing and of operating low temperature refrigeration systems embodying the invention, may be had by referring to the drawings accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a relatively large central vertical section through my improved positive refrigerant feeder, the section having been taken along the line 1—1 of Fig. 2 but the upper equalizing opening which is normally in front of the line 1—1 having been shown in dotted lines in order to indicate its relative position;

Fig. 2 is a somewhat reduced top view of the positive feed mechanism of Fig. 1;

Fig. 3 is a transverse horizontal section through the feed mechanisms of Figs. 1 and 2, taken along the line 3—3 of Fig. 1 and looking downwardly;

Fig. 4 is another transverse horizontal section through the same feed mechanism, taken along the line 4—4 of Fig. 1 and also looking downwardly;

Fig. 5 is an irregular vertical section taken through the lower head or base plate of the feed mechanism, along the lines 5—5 of Fig. 4; and

Fig. 6 is a diagram of an improved low temperature refrigeration system embodying one of the improved feed mechanisms, as well as other features of the present invention.

While the invention has been shown and described herein as being especially applicable to low-temperature high-pressure refrigeration systems, it is not my desire to unnecessarily restrict the utility of all features thereof to such systems.

Referring to the drawings, and more especially to Fig. 6, the improved refrigeration system shown therein comprises in general a plurality of cooling units or coils 8 having their upper inlet

3

ends connected with a positive refrigerant supply or feed mechanism 9 by means of feed pipes 10, while their lower outlet ends communicate with a low pressure accumulator or separator 11; a low pressure pump or compressor 12 having a suction line 13 communicating with the uppermost portion of the separator 11, and also having a discharge line 14; a high pressure pump or compressor 15 having its suction side connected to the low pressure compressor or intermediate discharge line 14, and also having a high pressure discharge line 16 communicating with a condenser 17; a high pressure liquid refrigerant accumulator and cooler 18 communicating with the condenser 17 past a float control valve 19 and through a liquid connection 20, and having a lower outlet 21 for liquid and an upper connection 22 for gaseous refrigerant; a valve controlled liquid refrigerant feed line 23 connecting the high pressure accumulator outlet 21 with the feed inlet opening 24 of the positive feed mechanism 9, and a valve controlled by-pass line 25 also connecting the outlet 21 with a passage 26 in the base plate 27 of the mechanism 9; an adjustable constant differential back pressure control valve 28 interposed between the accumulator connection 22 and the high pressure suction line 14, and being operable by variations in pressure in the suction line 13, to automatically maintain a constant and definite back pressure in the accumulator connection 22 regardless of variations in pressure in the suction line 14 of the high pressure compressor 15, and regardless of changes in load; a cold liquid return pipe 29 connecting the lowermost portion of the separator 11 with another passage 30 in the lower base plate 27 of the mechanism 9; and pressure equalizing connections 31, 32 connecting the separator 11 with the feed mechanism 9, and the accumulator connection 22 with the feed line 23, respectively.

While most of the individual elements or parts of the system including the coils 8, accumulator or separator 11, compressors 12, 15, condenser 17, intermediate accumulator and cooler 18, float valve 19, and the various connections, are of relatively standard and well known construction, their combination and association with the feed mechanism 9 and with the constant differential pressure valve 28 possesses advantages and produces desirable results not heretofore obtainable in connection with low temperature refrigeration systems. The adjustable constant differential valve 28 is also of the well known type frequently designated as an automatic back pressure valve, and is provided with adjustable springs which may be set to produce any desired constant pressure differential. The use of such a valve in conjunction with my positive feed mechanism, reduces the power consumption by avoiding necessity of mechanical propulsion of the high pressure refrigerant with the aid of pumps, simplifies the mechanism for insuring positive delivery and uniform distribution of the refrigerant to several cooling units, and insures an abundant and proper supply of refrigerant to each coil. By far the greater part of these advantageous results are produced by the positive feed mechanism 9 which is of special construction and which permits utilization of the high pressure normally existing in the intermediate accumulator and cooler 18, in order to insure abundant and uniform feeding of liquid refrigerant to the coils 8; and which is moreover adapted to positively and accurately deliver refrigerant to any desired number of units or coils 8.

4

The improved positive feed mechanism is shown in detail in Figs. 1 to 5 inclusive, and comprises a constantly rotatable cylinder or drum 33 having upper and lower closure heads 34, 35 respectively, and being provided with three internal radiating partitions 36 dividing the drum interior into three similar sector shaped chambers 37; a fixed cylindrical housing casing 38 enclosing the drum 33 and having upper and lower closure plates 39, 27 respectively, the former of which is provided with the feed inlet opening 24 and with another opening 40 communicating with the equalizing connection 31 while the latter is provided with the passages 26, 30 and with a multiplicity of refrigerant delivery passages 41 adapted to be connected with the pipes 10 leading to the cooling coils 8; an annular sealing plate or ring 42 interposed between the upper head 34 and plate 39 and being constantly resiliently urged against the head 34 by springs 43 located within the openings 24, 40; an upright shaft 44 journaled for rotation in an anti-friction bearing 45 carried by the upper plate 39 and having a bevel driving gear 46 at its upper end while its lower end 47 is polygonal in shape and fits within a similarly formed socket 48 formed centrally within the rotor head 34; and a power source such as an electric motor 49 coaxing through speed reducing mechanism and a bevel pinion 50 with the gear 46 so as to constantly revolve the drum 33 and heads 34, 35 at any selected uniform speed within the housing casing.

The rotor drum 33 may be formed from a piece of tubing welded or otherwise rigidly attached to the closure heads 34, 35, and the partitions 36 may be constructed of sheet metal likewise welded or otherwise rigidly secured to both the drum 33 and heads 34, 35. As shown in Fig. 3, the upper head 34 is provided with three equally spaced slots 51 which are periodically and successively communicable with the openings 24, 40 through passages 52 formed in the sealing ring 42; and the lower head 35 of the feed rotor is provided with a series of three equally spaced circular ports 53 which are periodically communicable with the passages 26, 30 through slots 54, 55 formed in the lower plate 27 as indicated in Figs. 3 and 4. The lower head 35 of the rotor is also provided with a series of small feed orifices 56 which are so located that they will intermittently or periodically register with ports 57 formed in the lower plate 27 and which communicate with the delivery passages 41; and while there are a number of these passages 41, some of them may be sealed with plugs 58 while others may be connected to the feed pipes 10 for the cooling coils 8, see Figs. 4, 5 and 6. The orifices 56 and ports 57 should preferably be so disposed that they will insure uniform periodic feeding of liquid refrigerant to the coil feed lines 10 from the successive revolving chambers 37, and while these chambers are subjected to high pressure; and in order to retain the feed rotor in central position within the casing 38, the lower head 35 may be provided with a centering lug 59 coaxing with a socket 60 in the lower plate 27.

The housing casing 38 may also be formed of a piece of tubing and the opposite ends of this casing may be fitted within annular recesses 61 formed in the upper and lower plates 39, 27 and clamped firmly within these recesses by means of nuts and bolts 62. This assemblage will retain the parts in place against internal pressure, while permitting ready dismantling of the housing for inspection of the feed rotor. In order to provide

5

a compact feed unit 9, the propelling motor 49 may be secured to a bracket 63 carried by the upper head 39, and the anti-friction bearing 45 and gears 46, 50 may also be associated with this bracket 63, see Figs. 1, 2 and 6. Possible escape of refrigerant from within the housing casing and along the shaft 44, is prevented by a special anti-friction high pressure seal shown in Fig. 1, and comprising upper and lower plates 64, 65 which are constantly urged away from each other by a spring 66, and coact with rings 67 which in turn engage packing rings 68. The springs 43 which constantly urge the annular sealing plate 42 against the upper head 34 of the feed rotor, also coact with expansible tubular corrugated sealing elements 69 disposed within the openings 24, 40, and with sealing rings 70 which engage bosses 71 formed on the plate 42. These bosses 71 in which the passages 52 are formed, are disposed approximately 180° apart and snugly but slidably engage parallel bores 72 in the upper plate 39, and the pipes 23, 31 are connected with their respective openings 24, 40 by means of clamping flanges 73 which also engage flanges 74 secured to the upper ends of the elements 69, thereby providing effective high pressure seals at the openings 24, 40. This assemblage of elements prevents undesirable escape of refrigerant from the interior of the rotor into the housing casing, and from the housing casing to the ambient atmosphere, and by spacing the exterior of the drum 33 from the interior of the casing 38 and providing antifriction bearings and seals wherever possible, the amount of power required to rotate or drive the feed rotor is reduced to a minimum.

The three-way constant differential pressure valve 28 which is operable by variations in pressure in the suction line 13, and is adapted to establish communication between the accumulator 18 and the high pressure suction line 14 of the compressor 15, may be of any well known type used quite extensively in the refrigerating industry, ordinarily embodying a valve actuating piston or diaphragm coacting with adjusting springs and exposed on opposite sides to the accumulator connection 22 and to the suction line 13 of the low pressure compressor 12. This valve 28 functions to maintain a constant or definite pressure differential between the low, intermediate and high pressure zones of the system by permitting gases from the accumulator to escape directly to the high pressure compressor 15 and thereby insures uniform feeding of the refrigerant.

During normal operation of the improved low temperature refrigeration system, the motor 49 should be operated to constantly rotate the positive feed drum 33 at the selected uniform speed, and means should be provided for varying this speed to meet requirements. The number of cooling coils 8 may also be increased or diminished according to requirements, and these coils should be connected to the feed passages 41 in the base plate 27 by connections 10. The high pressure feed pipe 23 should be open, and when the compressors 12, 15 are operating, liquid refrigerant under high pressure will be delivered from the condenser 17 to the accumulator 18 past the float control valve 19. As the feed rotor revolves, liquid refrigerant will be periodically delivered from the accumulator 18 through the supply pipe 23 and inlet opening 24 to the successive chambers 37 through the slots 51, thus substantially filling the chambers 37 with high pressure refrigerant.

6

Some of the refrigerant thus admitted to each chamber 37 is immediately discharged through the small orifices 56 to the ports 57 which communicate with the passages 41 and pipes 10 leading to the coils 8, thus admitting charges of liquid refrigerant to the cooling coils in rapid succession and at uniformly spaced intervals. The refrigerant escaping from the coils 8 passes into the low pressure accumulator or separator 11 from whence cold liquid refrigerant is returned by gravity through the connection 29 to the passage 30 in the base plate 27, and as each chamber 37 is revolved over the elongated port 55 communicating with the passage 30, cold liquid refrigerant is delivered thereto and the chamber is carried forward for subsequent communication with the inlet opening 24 and with the orifices 56. While the by-pass 25 may normally be closed, the valve in this by-pass can be opened at will so as to also admit liquid refrigerant directly from the accumulator 18 to each of the successive rotor chambers 37 through the passage 26 and port 54, and an abundance of liquid refrigerant within each chamber 37 may thus be insured at all times and especially when starting the system. This by-pass 25 may also be utilized to good advantage for reducing the capacity of the positive feeder, and when the valve in the by-pass is left fully open, liquid refrigerant under high pressure will flow through the successive chambers 37 and through the slots 51 and equalizer connection 31 directly to the low pressure zone of the system. This equalizer connection 31 will also serve to permit gases to escape from the chambers 37 directly to the separator 11, and the differential pressure valve 28 will function to automatically maintain a definite pressure differential between the low pressure, intermediate pressure and high pressure sides of the system. The equalizer connection 32 functions to equalize the pressures at the lower and upper ends of the accumulator 18 and should be used primarily when the by-pass 25 is utilized, and a closed system is thus provided wherein constant recirculation of the refrigerant may be automatically effected thus maintaining the entire cooling surface in contact with an abundant supply of evaporating liquid at all times.

From the foregoing detailed description it will be apparent that my present invention provides an improved low temperature refrigeration system wherein the refrigerant is positively fed to the cooling coils with minimum expenditure of power and in a most uniform and effective manner. The improved positive feed mechanism may obviously be utilized to feed refrigerant to any desired number of cooling units, and the refrigerant in the system is continuously and most effectively recirculated while the feeding of the refrigerant is accomplished primarily by the high pressure within the accumulator 18. The improved system is moreover extremely flexible in its operation and adaptations, and the by-pass 25 may readily be utilized to vary the capacity of the cooling coils 8 and of the system. While the improved system and feed mechanisms are especially adapted for use in connection with low temperature refrigerating installations, some of the features may obviously be more generally applied to other refrigeration systems, and the improved feeder is obviously so constructed that danger of escape of refrigerant is eliminated while the feeder may be operated with minimum power.

It should be understood that it is not desired to limit this invention to the exact details of con-

struction or to the precise mode of use of the apparatus herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

I claim:

1. In a low temperature closed refrigeration system, several cooling elements having their outlets connected to a low pressure zone, a pair of compressors connected in series for delivering refrigerant from said low pressure zone to a high pressure zone, feed means for periodically delivering liquid refrigerant under the influence of the high pressure in said high pressure zone successively to the inlets of said cooling elements, and means for conducting cold liquid refrigerant directly from said low pressure zone to said feed means.

2. In a low temperature refrigeration system, several cooling coils having their outlets connected to a low pressure accumulator, low and high pressure compressors connected in series for delivering gaseous refrigerant from said accumulator to a high pressure condenser, a high pressure accumulator and auxiliary cooler communicating with said condenser, and feed mechanism for periodically delivering liquid refrigerant to the inlets of said coils under the influence of the pressure in said high pressure accumulator.

3. In a low temperature refrigeration system, several cooling coils having their outlets connected to a low pressure accumulator, low and high pressure compressors connected in series for delivering gaseous refrigerant from said accumulator to a high pressure condenser, a high pressure accumulator and auxiliary cooler communicating with said condenser, feed mechanism for periodically delivering liquid refrigerant successively to the inlets of said coils under the influence of the pressure in said high pressure accumulator, and means for returning cold liquid refrigerant directly from said separator to said mechanism.

4. In a low temperature refrigeration system, several cooling units having their outlets connected to a low pressure accumulator, means for compressing the gases from said accumulator and for converting the same into high pressure liquid refrigerant, a constantly rotating mechanical feeder for intermittently delivering said high pressure liquid refrigerant to the inlets of said units, and means for returning cold liquid refrigerant from said accumulator directly to said feeder.

5. In a low temperature refrigeration system, several cooling units having their outlets connected to a low pressure accumulator, means for compressing the gases from said accumulator and for converting the same into high pressure liquid refrigerant, a constantly rotating feeder having

a series of segregated revolving chambers and parts through which high pressure liquid refrigerant is successively delivered from the high pressure source to said units, and means for by-passing high pressure liquid refrigerant around said parts directly from said first mentioned means to said units through said feeder chambers.

6. In a low temperature refrigeration system, several cooling units having their outlets connected to a low pressure accumulator, means for compressing the gases from said accumulator and for converting the same into high pressure liquid refrigerant, a constantly rotating feeder having a series of segregated revolving chambers through which high pressure liquid refrigerant is successively delivered from the high pressure source to said units, and means for returning cold liquid refrigerant from said low pressure accumulator directly to the successive chambers of said feeder.

7. In a low temperature refrigeration system, several cooling coils having their outlets connected to a low pressure accumulator, low and high pressure compressors for delivering gaseous refrigerant from said accumulator to a high pressure condenser, a high pressure accumulator and auxiliary cooler communicating with said condenser, means for returning gaseous refrigerant from said high pressure accumulator directly to said high pressure compressor, and feed mechanism for periodically delivering liquid refrigerant to the inlets of said coils under the influence of the high pressure in said high pressure accumulator.

8. In a low temperature refrigeration system, several cooling coils having their outlets connected to a low pressure accumulator, low and high pressure compressors for delivering gaseous refrigerant from said accumulator to a high pressure condenser, a high pressure accumulator and auxiliary cooler communicating with said condenser, means for returning gaseous refrigerant from said high pressure accumulator directly to said high pressure compressor, feed mechanism for periodically delivering liquid refrigerant to the inlets of said coils under the influence of the high pressure in said high pressure accumulator, and means for returning cold liquid refrigerant directly from said low pressure accumulator to said mechanism.

ERNST S. H. BAARS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
Re. 4,992	Martin et al.	July 16, 1872