

July 13, 1943.

R. H. MEYERHANS

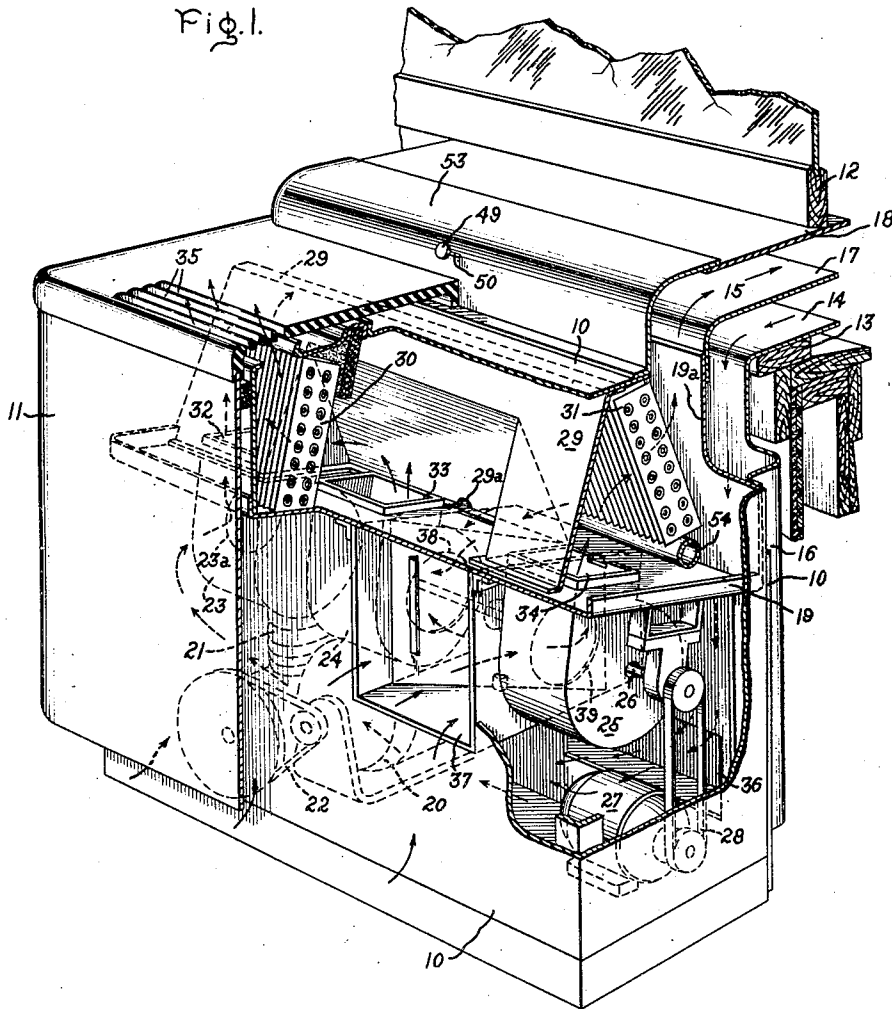
2,324,313

AIR CONDITIONING APPARATUS

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2 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

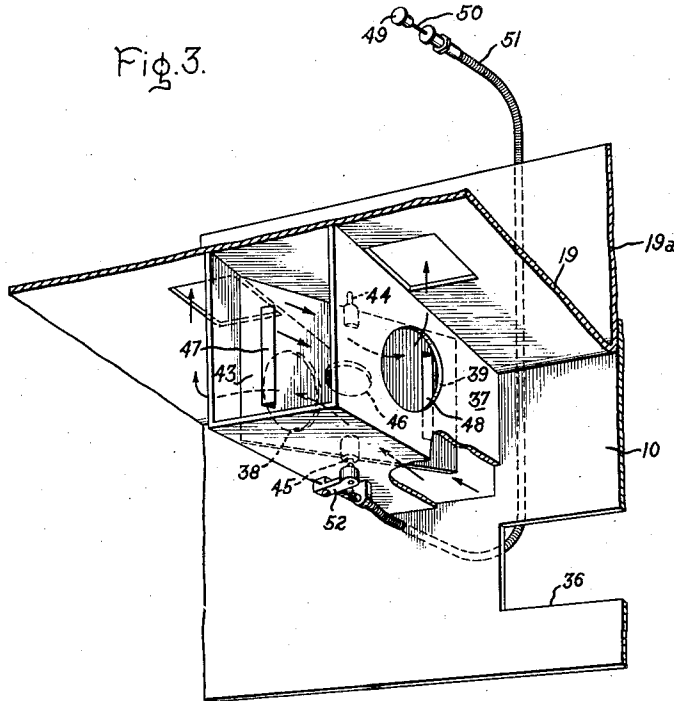


Fig. 2.

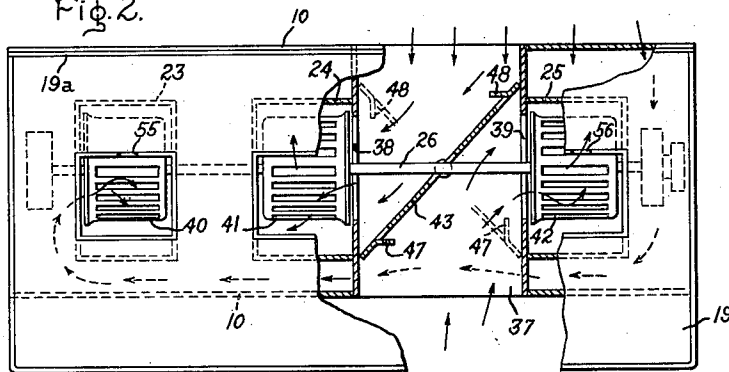
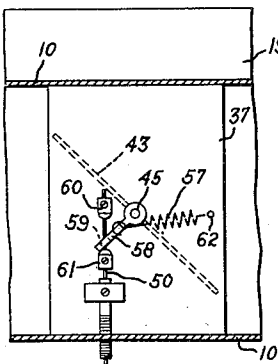


Fig. 4.



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UNITED STATES PATENT OFFICE

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AIR CONDITIONING APPARATUS

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9 Claims. (Cl. 62—129)

My invention relates to air conditioning apparatus and particularly to portable room cooling units including a complete refrigerating mechanism.

Portable air conditioning units frequently are constructed so that the entire mechanism is contained within a single casing and requires only a fresh air duct leading to the outside of the building and a connection to a suitable source of electric power. These units ordinarily include refrigerating machines having the motor-compressor unit and condenser thereof cooled by the circulation of air over their surfaces, the air thus heated being discharged to the outdoors. Any moisture condensed on the evaporating coil during the cooling of the air to be circulated through the room is vaporized, collected and discharged to the outside with the warm condenser air. By arranging the air-cooled condenser in this manner and also utilizing the condenser air for the removal of condensed moisture, the necessity of providing water cooling and drain connections is avoided. Since room cooling units are required to operate under widely varying conditions of temperature and humidity, it is desirable that some arrangement be provided to select the amount of fresh air and recirculated air which is to be cooled by the unit and discharged into the room. Furthermore, it is desirable that when fresh air is being taken into the room to be cooled, a corresponding amount of room air be discharged in order to provide positive ventilation. It is also desirable that the entire unit including the necessary duct structure and control dampers be made as compact as possible so that the unit will require a minimum of space within the room.

It is an object of my invention to provide an air-cooled room cooling unit including a complete refrigerating machine and an arrangement whereby a minimum amount of space shall be required for the air circulating ducts.

It is another object of my invention to provide an air-cooled room cooling unit including a complete refrigerating machine and an improved arrangement affording selective control of the air paths within the unit and which shall require a minimum amount of space.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention,

reference may be had to the accompanying drawings in which Fig. 1 is a perspective view partly in section showing an air conditioning unit embodying my invention installed in position adjacent a window opening; Fig. 2 is a top plan view partly in section of the unit shown in Fig. 1, with the outer cabinet and the portions above the horizontal partition removed; Fig. 3 is a perspective view of a portion of the air conditioning unit shown in Fig. 1 more clearly showing the damper and its operating mechanism; and Fig. 4 is a plan view showing a modified arrangement of the damper operating mechanism.

The air conditioning unit illustrated in the drawings and more fully described below comprises generally an air-cooled room cooler of the portable type provided with a refrigerating machine having an evaporating coil for cooling the air within the room and a plurality of fans arranged to circulate either room air or fresh air over the evaporating coil and into the room and simultaneously to circulate air over the motor-compressor unit and the condenser of the refrigerating machine to cool these parts and remove the heat from the room by discharging it with the air to the outside. Under varying weather and temperature conditions, it may be desirable to circulate fresh and room air in different proportions over the surface of the evaporator and into the room and there is, therefore, provided an arrangement which makes it possible to circulate all room air or all fresh air or a mixture of both over the evaporator and into the room. At the same time, the condenser air path is changed so that either fresh or room air or a mixture of both is circulated over the condenser and other warm parts of the refrigerating machine and is discharged to the outdoors. By providing a single damper mechanism arranged in a box or chamber between the inlets to the fans for the evaporator and condenser air paths considerable economy of space is obtained as well as easy and positive control of the several air paths.

Referring now to the drawings, in Fig. 1 I have shown an air conditioner including a sheet metal casing 10 provided with a finished cabinet cover 11 surrounding the casing on the front, sides, and top and spaced from the casing in the lower portion of the front thereof to provide an inlet for room air. The casing is positioned adjacent a window opening and has an air duct extending from the casing to the outdoors between a raised window sash 12 and a sill 13. The air duct comprises an intake passage 14 and

a discharge passage 15. The intake passage 14 has a horizontal portion extending through the window and a vertical portion formed between the rear wall of the casing 10 and a sheet metal channel 16 secured to the rear wall. The discharge duct is formed by plates 17 and 18, the plate 17 constituting the upper wall of the horizontal portion of the inlet duct 14. The casing 10 is divided into upper and lower compartments by a longitudinal partition 19 which slants at a slight angle toward the rear of the casing and is formed with an upwardly extending rear wall 19a forming part of the casing 10. The compartment below the partition 19 is the machinery compartment containing the motor-compressor unit and the air circulating motor and fans. The motor-compressor unit includes a motor 20 arranged to drive a compressor 21 through a belt 22. Three fans mounted in scrolls or housings 23, 24 and 25 are provided to circulate the air through the several air paths and are mounted on a common shaft 26 driven by a motor 27 through a belt 28. The portion of the casing above the partition wall 19 is divided into a front compartment and a rear compartment by a wall 29; the front compartment contains a cooling unit or evaporator 30, and the rear compartment contains a condenser or heat dissipating unit 31. The evaporator 30 and the condenser 31 are connected in a closed refrigerant circuit with the compressor 21 so that hot compressed refrigerant discharged from the compressor flows into the condenser where it is cooled and liquefied, the liquid refrigerant then being admitted to the evaporator under control of a suitable expansion valve in the manner well known in the art. Refrigerant in the evaporator is vaporized by the absorption of heat from air passing over the outside of the evaporator and the vaporized refrigerant is withdrawn from the evaporator and returned to the compressor. This cycle is continuous as long as the compressor is in operation. The fans within the scrolls 23, 24 and 25 are all arranged to discharge air upwardly through fan scroll outlets 32, 33 and 34, respectively, and the partition 29 is shaped with angularly offset portions so that air from the discharge outlets 32 and 34 is directed into the rear compartment and over the condenser and air from the discharge outlet 33 is directed into the front compartment and over the evaporator.

During the operation of the conditioner, room air is admitted to the space between the cabinet 11 and the casing 10 at the lower end of the cabinet as indicated by the arrows, and conditioned air is discharged into the room from the evaporator compartment through an outlet grille 35. Fresh outside air is admitted to the machinery compartment from the inlet duct 14 through an opening 36, as indicated by arrows, and is circulated over the motors 20 and 27 and the compressor 21 by operation of the fan in the scroll 23; after removing heat from the machinery compartment the air is returned to the outdoors over the condenser and through the duct 15.

Between the fan housings 24 and 25 is arranged an open-ended rectangular box or chamber 37 communicating with the fan scrolls 24 and 25 through their circular inlet openings indicated at 38 and 39, respectively. The front end of the box 37 opens into the space between the cabinet 11 and the front wall of the casing 10 and, therefore, receives room air, as indicated by the arrows. The rear end of the box 37 opens into

the duct 14 in the back of the casing 10 and, therefore, receives fresh air. The arrangement of the three air circulating fans and the positions of the inlets and outlets of the box 37 are clearly shown in Fig. 2 where the air circulating fans within the housings 23, 24 and 25 are indicated by the numerals 40, 41 and 42, respectively. Air from the box 37 is drawn into the fans 41 and 42 and discharged into the front 10 and rear compartments to be circulated over the evaporator and condenser, respectively.

A single damper 43 is provided within the box 37 to control the air paths. This damper is mounted within the box to rotate on a central vertical axis on upper and lower trunnions 44 and 45 respectively. When the damper is in the position shown in Fig. 2, the fan 41 receives fresh air from the rear inlet of the box 37 and the fan 42 receives room air from the front inlet of the box. When the damper is moved to its other extreme position indicated by dotted lines, the fan 41 receives room air and the fan 42 fresh air. In intermediate positions of the damper, a mixture of fresh and room air is delivered to both fans, the proportion of fresh and room air delivered to each fan being substantially the inverse of the proportion of fresh and room air delivered to the other fan, the total volumes remaining substantially constant. A round hole 46 is provided in the center of the damper in order that the fan drive shaft 26 may pass therethrough. Vertical louvers 47 and 48 may be provided in the damper so that a small portion of fresh air will enter the room through the fan 41 when the damper is in its dotted line position. The louvers 47 and 48 offer greater resistance to flow of air therethrough in one direction than in the other; the resistance being less, with respect to flow of air from the fresh and room air inlets, when the damper is in the dotted line position than when it is in the full line position. Furthermore, when the damper 43 is in the dotted line position the louver 48 is in position near the intake of the evaporator fan 41 and some fresh air is drawn into the fan through the louver 48; a corresponding amount of room air is exhausted through the louver 47 into the condenser fan 42. In the full line position of the damper relatively little air passes through the louvers from either the fresh or room air inlets.

In order to operate the damper 43 from the outside of the unit, I provide a knob 49 on one end of a flexible cable or Bowden wire 50 arranged to be longitudinally slidable in a sheath 51 to actuate a crank arm 52 connected to the lower trunnion 45 of the damper. The knob 49 may be reached from the top of the unit where the wire 50 extends through a curved control panel 53 which also forms a portion of the top of the duct 15.

The arrangement of the damper 43 in box 37 provides a very simple and effective device for changing the circulating air paths and varying the proportions of fresh and recirculated air and affords positive ventilation. The air path from the fresh air inlet 36 to the inlet of the housing 23, indicated at 23a, is independent of the evaporator air path and remains open at all times so that as long as the fan motor 27 is in operation the fan 40 produces a continuous circulation of air through the machinery compartment and adequate removal of waste heat and obnoxious machinery odors is assured. Furthermore since the fan 40 is on the outlet side

of the machinery compartment, that compartment is normally at a lower pressure than the room and this prevents leakage into the room of air containing odors from the machinery compartment.

During the operation of the air conditioning unit, moisture may be condensed on the evaporator coil 30. This condensed moisture will collect and flow downwardly along the inclined surface of the longitudinal partition 19 and through a suitable opening in the wall 29, such as indicated at 29a and will collect along the rear edge thereof. It is to be noted that the discharge ends of the fan scrolls 23, 24 and 25 extend above the surface of the plate 19 so that the water does not flow immediately into any of the scrolls but must first collect along the rear of the plate 19 where is located a liquid receiver 54 directly below the condenser 31. The hot refrigerant liquid in the receiver 54 heats the water in the pan 19 and the vaporized water is removed with the stream of air flowing over the condenser and out through the duct 15. Should excessive water be condensed it will overflow from the pan 19 into the scrolls 23 and 25 through cut away portions 55 and 56, respectively, and will drip onto the rotating fans 40 and 42 which will throw the water over the condenser where it will be vaporized and then removed from the unit with the condenser air. When there is a large amount of excess water, it will collect at the bottom of the fan scrolls and may be picked up by portions of the fans or members rotating therewith in a manner known to the art. This arrangement slings or throws the water against the condenser surface.

Although the damper arrangement shown in Fig. 2 makes it possible to obtain any proportion of fresh and recirculated air, it may be desirable in some types of units to arrange the damper so that it can be stopped only in its extreme positions. In Fig. 4, the damper 43 is shown connected for operation by the Bowden wire 50 through an overcenter spring 57. The spring 57 is connected to an arm 58 secured to the lower trunnion 45 of the damper and taking the place of the arm 52 of the control shown in Fig. 3. The wire 50 passes through an opening 59 in the arm 58 and is provided with two spaced apart stops 60 and 61. The overcenter spring 57 is pivoted to the box 37 at 62 and at its other end to the arm 58. When the wire 50 is extended upwardly, as viewed in Fig. 4, the stop 61 will move the arm 58 and the damper 43 in a clockwise direction until the spring 57 passes over the center 45, the spring will then continue the clockwise rotation of the arm 59 until the damper rests in its extreme position opposite the one illustrated in the figure. On the return of the wire 50, the stop 60 will move the arm 49 and the damper in a counterclockwise direction until past the center position of the spring 57, which then completes the movement. The space between the stops 60 and 61 along the wire 50 is provided to accommodate movement of the damper arm by the spring 57 after the overcenter position has been reached.

From the foregoing, it will readily be apparent that I have provided a simple and compact arrangement of rugged construction for selectively changing the air paths in an air conditioning apparatus and that this arrangement makes possible a very substantial saving in duct structure and in the size of an air conditioning unit.

While I have shown and described my invention in connection with a particular type of air conditioning unit, other applications will readily be apparent to those skilled in the art. I do not, therefore, desire my invention to be limited to the particular construction shown and described, and I intend in the accompanying claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An apparatus for conditioning the air within a room comprising a casing having two inlets one for fresh air and the other for room air and two outlets one for discharging air into the room and the other for discharging air to the outside, said casing having a chamber therein provided with two air inlets and two air outlets, means for connecting said inlets and said outlets of said chamber respectively with said inlets and said outlets of said casing, means for producing a circulation of air from said inlets of said casing through said chamber to said outlets of said casing, and damper means arranged in said chamber for selectively connecting said inlets thereof to said outlets thereof to vary from substantially all fresh air to substantially all recirculated air, the proportions of fresh and recirculated air discharged into the room through said one outlet of said casing.

2. An apparatus for conditioning the air within a room comprising a casing having an inlet for room air and an air inlet for outside air and two outlets one for communication with the room and the other for communication with the outside, a first fan for discharging air solely through said one outlet, a second fan for discharging air solely through said other outlet, means providing a chamber between said fans and in communication with said room air and outside air inlets, and a single damper arranged in said chamber for changing the proportions of room and outside air admitted to said fans from said chamber.

3. An apparatus for conditioning the air within a room comprising a casing having an inlet for room air and an inlet for outside air and two outlets one for communication with the room and one for communication with the outside, a pair of centrifugal type fans and housings therefor spaced apart axially of said fans, means providing a box-like chamber between said fans and having inlets communicating with said inlets of said casing, said fan housings having inlets opening into said chamber, and a single damper pivotally mounted in said chamber and movable from one extreme position to another for changing the proportions of room air and of outside air admitted to said fans from said chamber, said damper in one of its extreme positions admitting substantially only outside air to one of said fans and substantially only room air to the other of said fans and in its other extreme position admitting substantially only room air to said one fan and substantially only outside air to said other fan.

4. An apparatus for conditioning the air within a room comprising a casing having a first outlet for discharging air into the room and a second outlet for discharging air outside the room and two inlets one for room air and the other for fresh air, means forming air passages within said casing for providing air circulating paths from said inlets to said outlets, means for producing a circulation of air through said air passages,

and a single damper selectively operable to either of two positions for determining the air paths between said inlets and said outlets, said damper in one of said positions directing air from said fresh air inlet to said first outlet and from said room air inlet to said second outlet, said damper in the second of said positions directing air from said fresh air inlet to said second outlet and from said room air inlet to said first outlet, said damper having an opening therein for affording a passage of air therethrough and means arranged adjacent said opening for providing greater resistance to the flow of air through said opening in one direction than in the other whereby when said damper is in said second position a quantity of fresh air is added to the room air directed toward said first outlet.

5. An apparatus for cooling the air within a room comprising a casing having a plurality of compartments therein, a first one of said compartments having an inlet for room air and an inlet for outside air, a heat absorbing element in a second one of said compartments, a heat dissipating element in a third one of said compartments, said casing having a first outlet communicating only with said second compartment and a second outlet communicating only with said third compartment, means including outlets in said first compartment for circulating air from said first compartment through said second and third compartments over said heat absorbing and dissipating elements and out of said first and second outlets of said casing, and means in said first compartment for selecting simultaneously the proportions of room and outside air circulated through each of said first and second outlets.

6. An apparatus for cooling the air within a room comprising a casing having a room air inlet and an outside air inlet and two outlets one for communication with the room and the other for communication with the outside, a refrigerating machine including an evaporator and a condenser arranged in said casing, means providing a path for conducting air over said evaporator and out of said casing through said one outlet, means providing a path for conducting air over said condenser and out of said casing through said other outlet, means for providing a circulation of a substantially constant volume of air through each of said paths, and means including a damper and connecting said air paths and said inlets for changing simultaneously the proportions of fresh and outside air conducted to each of said air paths from said inlets whereby the air discharged to the room may be selected to be substantially all fresh air or substantially all recirculated air or a desired proportion of each.

7. An apparatus for cooling the air within a room comprising a casing having a plurality of compartments therein, a first one of said compartments having an inlet for room air and an inlet for outside air, a heat absorbing element in a second one of said compartments, a heat dissipating element in a third one of said compartments, said casing having a first outlet communicating only with said second compartment and a second outlet communicating only with said third compartment, means including a first fan for circulating air from said first compartment through said second compartment to the

room through said first outlet, means including a second fan for circulating air from said first compartment through said third compartment to the outside through said second outlet, and a single pivotally mounted damper arranged in said first compartment for selecting simultaneously the proportions of room air and of outside air circulated by each of said fans.

8. An apparatus for cooling the air within a room comprising a casing having a plurality of compartments therein, a refrigerating machine arranged in said casing and comprising a motor-compressor unit and a condenser and an evaporator connected in a closed refrigerating circuit, said motor-compressor unit being arranged in a first one of said compartments, said condenser being arranged in a second one of said compartments, said evaporator being arranged in a third one of said compartments, means providing communication between a fourth one of said compartments and said second and third compartments, said fourth compartment having an inlet for room air and an inlet for outside air, said second compartment having an outlet for communication with the outside, said third compartment having an outlet for communication with the room, means for circulating air from said fourth compartment through said second compartment to the outside and for circulating air from said fourth compartment through said third compartment to the room, damper means arranged in said fourth compartment for selecting simultaneously the proportions of room air and outside air circulated through each of said second and third compartments, and means for circulating air through said first compartment to cool said motor-compressor unit and for discharging the air to the outside.

9. An apparatus for cooling the air within a room comprising a casing having a plurality of compartments therein, a refrigerating machine arranged in said casing and comprising a motor-compressor unit and a condenser and an evaporator connected in a closed refrigerating circuit, said motor-compressor unit being arranged in a first one of said compartments, said condenser being arranged in a second one of said compartments, said evaporator being arranged in a third one of said compartments, means providing communication between a fourth one of said compartments and said second and third compartments, said fourth compartment having an inlet for room air and an inlet for outside air, said second compartment having an outlet for communication with the outside, said third compartment having an outlet for communication with the room, three fans and a common driving shaft therefor, one of said fans being arranged to circulate air from said fourth compartment through said second compartment over said condenser to the outside, another of said fans being arranged to circulate air from said fourth compartment through said third compartment over said evaporator to the room, the third one of said fans being arranged to circulate air through said first compartment over said condenser to the outside to cool said motor-compressor unit, and damper means arranged in said fourth compartment for selecting simultaneously the proportions of room air and outside air admitted to each of the first two of said fans.

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