NBS TECHNICAL NOTE 536

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ICATION

DISCLOSURES ON:

Viscous Damped Wind Vane
Nonskid Road or Runway
Regrooved Pneumatic Tire With Removable Inserts
Device for Radially Positioning a Rotating Wheel
Method for Fabricating Precision Waveguide Sections
Distortion-Cancelling Loudspeaker System
Cryogenic Fluid Density Measurement System
Controlled-Atmosphere Weathering Device

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NBS TECHNICAL NOTE 536

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Editors: David Robbins and Alvin J. Englert

Patent Advisor's Office
National Bureau of Standards
Washington, D. C. 20234

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This NBS Technical Note is one of a continuing series entitled "Disclosures on ...." This series consists of short descriptions of recent developments from the Department of Commerce primary operating units, departmental staff offices, and their contractors. It is believed that these developments have important commercial applications. Unless otherwise stated in the description of a development, the property rights therein have been retained by the United States as represented by the Secretary of Commerce.

Previous NBS Technical Notes in this series are NBS Technical Notes 237, 253, 263, 282, 287, 295, 437 and 440.

David Robbins
Patent Advisor

CONTENTS

ABSTRACT

This Note describes and illustrates eight developments that are believed to embody interesting and unusual solutions to current problems in their fields.

KEY WORDS

Accelerated weathering test; acoustic distortion, cancelling; averaging wind vane; cryogen density, measuring; distortion-cancelling loudspeakers; grooved runway; hydroplaning skidding, prevention of; loudspeaker system; photoactivated weathering test; radial positioning, wheel on shaft; rubber-surfaced road; slush cryogen density; tire groove insert; tire regrooving; waveguide, precision fabrication; waveguide, adjustable width; weathering test; wheel-shaft angle, shifting during rotation; wind vane, damped.

VISCOUS DAMPED WIND VANE

Donald T. Acheson
Herman H. Crouser

This instrument continuously displays average--rather than instantaneous--wind direction. As shown in Fig. 1, it includes a wind vane 10 secured to a vane shaft 12 that rotates in suitable bearings, not shown. The vane shaft 12 has a crank arm 14 and a crank shaft 16. A pulley 18 having a bearing 19 rotates on the crank shaft 16. A coil spring 20 is looped about the pulley 18, as shown in Fig. 2. The ends of spring 20 are connected to pins 21 that are fastened to a circular plate 22. The hub of plate 22 is fastened to an output shaft 24 that rotates in bearings 26 mounted in a stationary housing 28. The housing 28 has a ring-shaped well 27 that is filled with a viscous silicone damping fluid 30. A damping cylinder 32 formed integrally with the circular plate 22 dips into the damping fluid 30. The output shaft 24 drives a remote wind direction indicator 34 through a connection, e.g., electrical, represented by the dashed line 33. A compass card 35 displays the compass directions.

In the operation of the instrument, the wind vane 10 rotates the vane shaft 12, and therefore cranks the pulley 18, in accordance with the instantaneous wind direction. The pulley 18 exerts a torque on the plate 22 through the spring 20. The plate 22 however is restrained by the damping force exerted on the damping cylinder 32 by the viscous fluid 30 in the stationary well 27. Therefore the plate 22, and the output shaft 24 and indicator 34 connected thereto, are constrained to the average angular position of the wind vane 10. In other words, the output shaft 24 and indicator 34 effectively do not respond to fluctuations in wind direction that average to zero, but only to sustained changes in wind direction.

VISCOUS DAMPED WIND VANE

Donald T. Acheson
Herman H. Crouser

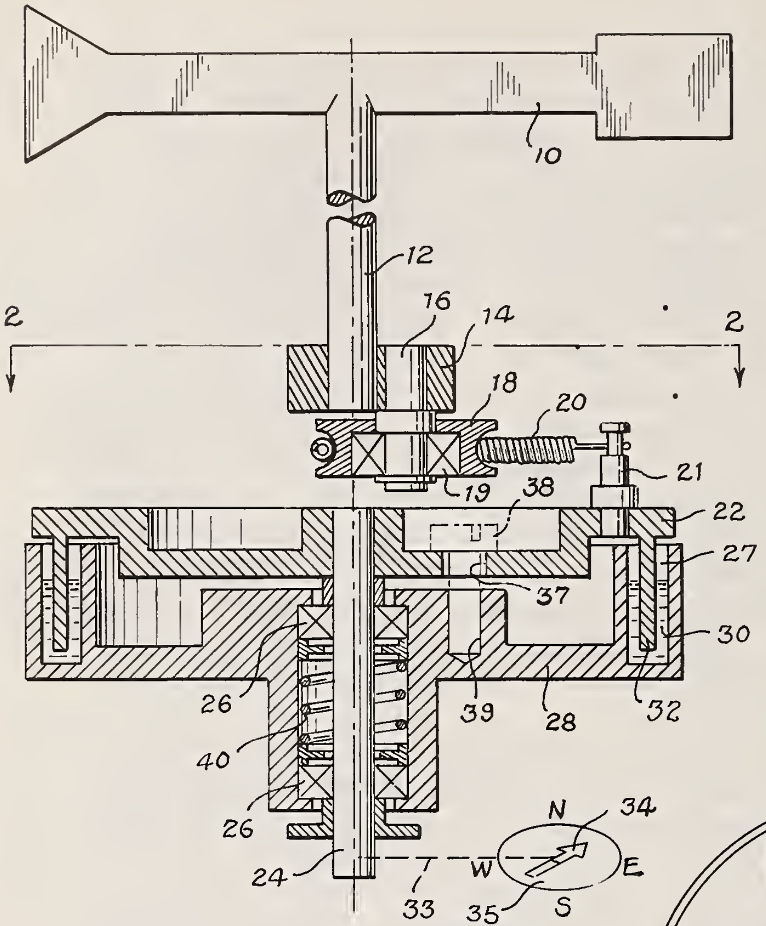


Fig. 1

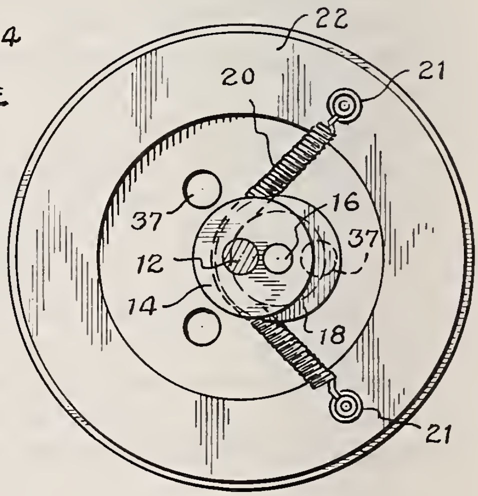


Fig. 2

Since the spring 20 is not fastened to the crank shaft 16 but rather is looped about the pulley 18 that rotates on the crank shaft, the spring cannot be damaged by excessive rotation of the wind vane 10--the effect known as wind vane breakaway.

The instrument can be stored or shipped without draining the damping fluid 30. The fluid is retained in the instrument by drawing the circular plate 22 down to the stationary housing 28, thereby sealing the well 27. The plate 22 has three holes 37, Fig. 2, through which shipping screws such as shown in dashed lines at 38 in Fig. 1, can be inserted to engage threaded holes 39 in the housing 28. As the plate 22 moves down, the upper bearing 26 compresses spring 40. When the shipping screws 38 are subsequently removed to place the instrument in operation, the spring 40 returns the bearing 26 to its normal position and thereby lifts plate 22 and unseals the well 27.

NONSKID ROAD OR RUNWAY

F. Cecil Brenner

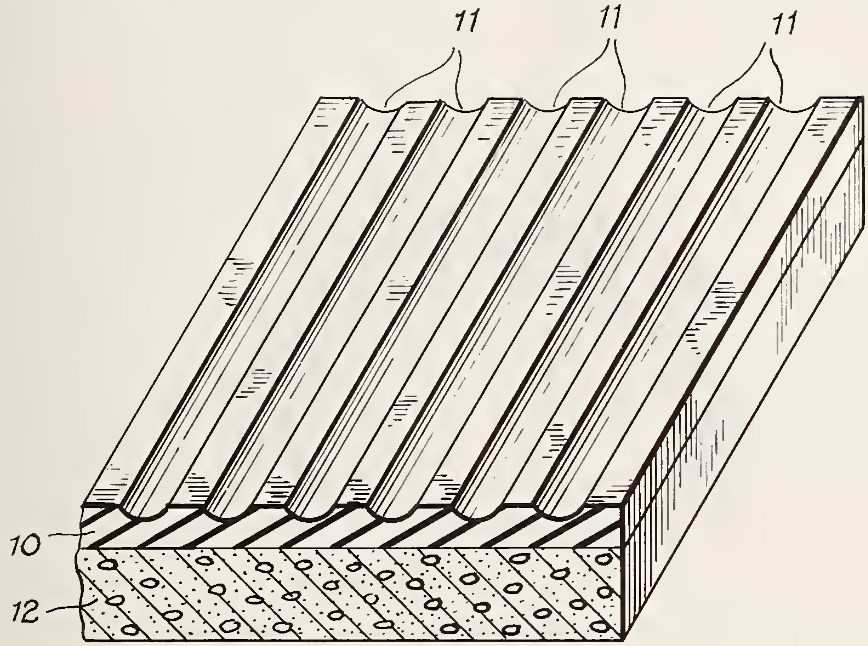
Grooves are presently cut into concrete or asphalt roads and airplane runways to prevent hydroplaning. The grooves however induce "chevron cuts" in the tires. In addition, groove-cutting resurfacing requires considerable time and requires closing down the runway or road for relatively long periods.

In the figure, a rubber mat 10 with parallel grooves 11 is bonded to a road or runway 12. The grooves are positioned perpendicular to the direction of movement of a vehicle on 12.

Mat 10 can absorb greater quantities of braking energy than concrete or asphalt, and grooves 11 provide rapid drainage of water to prevent hydroplaning and other forms of skidding during rainy periods. The mat may be removed and a new one installed rapidly with minimum delay in returning the runway or road to use.

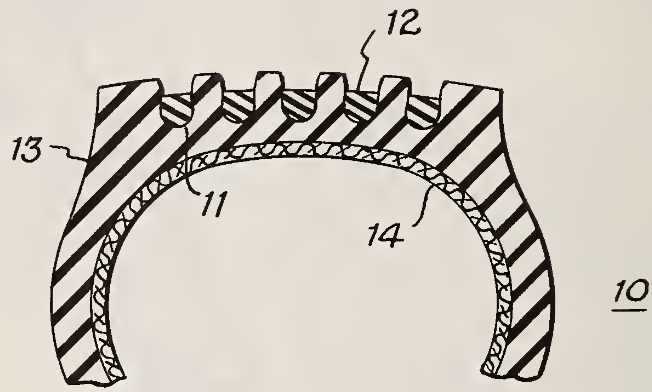
NONSKID ROAD OR RUNWAY

F. Cecil Brenner



REGROOVED PNEUMATIC TIRE WITH REMOVABLE INSERTS

F. Cecil Brenner



REGROOVED PNEUMATIC TIRE WITH REMOVABLE INSERTS

F. Cecil Brenner

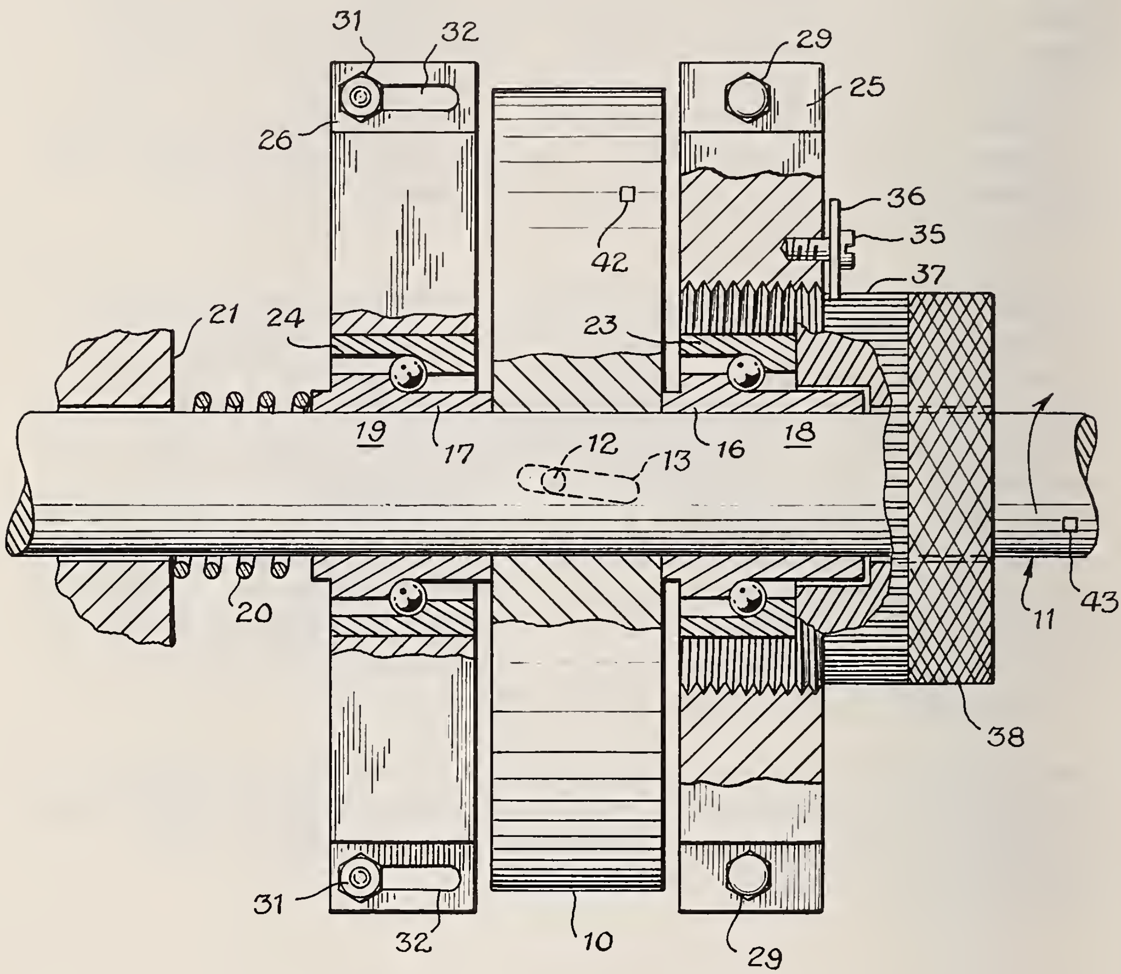
Taxi and bus tires are presently manufactured with an extra layer of rubber between the bottom of the molded groove and the fabric carcass. When the groove depth is worn to about 1/8 of an inch, new grooves are cut into the tire with a hot knife. This process is costly in terms of time and labor. In addition, sometimes the regroover will cut too deeply and damage the fabric, destroying the carcass.

Normally a tire is molded with a 1/2-inch groove depth, with an additional 1/2 inch between the bottom of the groove and the fabric carcass. In accordance with this note, tire 10 in the figure is constructed with the same amount of rubber but grooves 11 are molded to a full 7/8-inch depth. After the tire is removed from the mold an insert 12, approximately 1/2-inch thick, is placed in the bottom of each groove. The inserts may be glued to the main body 13 so that they will remain fixed in position. When the tire has been worn to where the thread depth is only 1/8 inch, the insert may be removed, producing a new tire with a full-groove depth.

There are three advantages to this arrangement: the original tread design is retained, the cost of regrooving is greatly reduced, and there is no possibility of damage to the fabric carcass 14.

DEVICE FOR RADIALLY POSITIONING A ROTATING WHEEL

Delmar J. Collenberger



DEVICE FOR RADIALLY POSITIONING A ROTATING WHEEL

Delmar J. Collenberger

This device may be used to vary the radial position of a wheel relative to the shaft on which it is mounted, while the wheel and shaft are in rotation.

Wheel 10 is slidably mounted on shaft 11, and pin 12 on the wheel is positioned in slot 13 located in the shaft. The inner races 16 and 17 of bearings 18 and 19, respectively, are slidably mounted on the shaft 11 with sufficient friction to rotate with 11. Inner race 17 is spring loaded with spring 20 and fixed member 21. The outer races 23 and 24 of the bearings are mounted in support brackets 25 and 26, respectively. Bracket 25 is fastened to a fixed member (not shown) with bolts 29, while bracket 26 is slidably mounted on the fixed member through bolts 31 and slots 32.

In a typical operation, the position of a reference mark 42 on wheel 10 is changed relative to a similar mark 43 on shaft 11 while the shaft and wheel are rotating. To accomplish this, screw 35 is loosened and pawl 36 now allows teeth 37 and knob 38 to rotate. Knob 38 is rotated clockwise so that 38 advances into bracket 25. The end of the knob, which is positioned against the end of outer race 23, moves bearing 18 and wheel 10 to the left in the figure. As the wheel and bearing slide to the left, bearing 19 moves in the same direction, compressing spring 20 an additional amount. Again, as wheel 10 slides longitudinally to the left on shaft 11, its pin 12 moves along slot 13, changing the radial position of mark 42 relative to mark 43.

METHOD FOR FABRICATING PRECISION WAVEGUIDE SECTIONS

Delmar J. Collenberger
George R. Gieseke
William J. Foote

The usual techniques for fabricating precision waveguide sections fail to achieve tolerances better than ± 0.0002 inch, which limits the degree of accuracy that can be attained in making microwave impedance measurements. The present technique provides waveguide sections with tolerances of ± 0.00005 inch. The sections are an integral part of some measurement systems in use at the National Bureau of Standards.

As an example, in fabricating a WR90 waveguide, bars 12 and 13 (Fig. 1) are used as gauge blocks and are milled to slightly less than 0.400 inch in the H dimension. The bars are silver plated to slightly more than 0.400 inch, ground to a roughness height of 5-6 microinches AA (arithmetical average), and lapped to as near 0.400 inch as possible. The maximum possible flatness is maintained of all surfaces which form the internal walls of the waveguide and care is exercised to maintain the squareness of bars 12 and 13. Bars 10 and 11 are ground and lapped on the surfaces that will form the internal walls of the waveguide. The waveguide is preferably made of Invar because of its very low thermal coefficient of expansion.

Clamping bolts (not shown) are positioned in holes 17 and securely tightened. The holes pass through bars 10, 12, and into bar 11. Eccentric shafts 18 are installed in holes 19, as shown in Fig. 2, and bolts 20 are positioned in holes 21 but are not tightened, as shown in Fig. 3.

At assembly, an appropriate airgauge spindle is inserted into the waveguide and the eccentric shafts 18 are rotated one at a time to move bar 13 toward or away from bar 12 as required to establish dimension W (0.900 inch.) After W is adjusted within very small tolerances clamping bolts 20 are securely tightened.

METHOD FOR FABRICATING PRECISION WAVEGUIDE SECTIONS

Delmar J. Collenberger
George R. Gieseke
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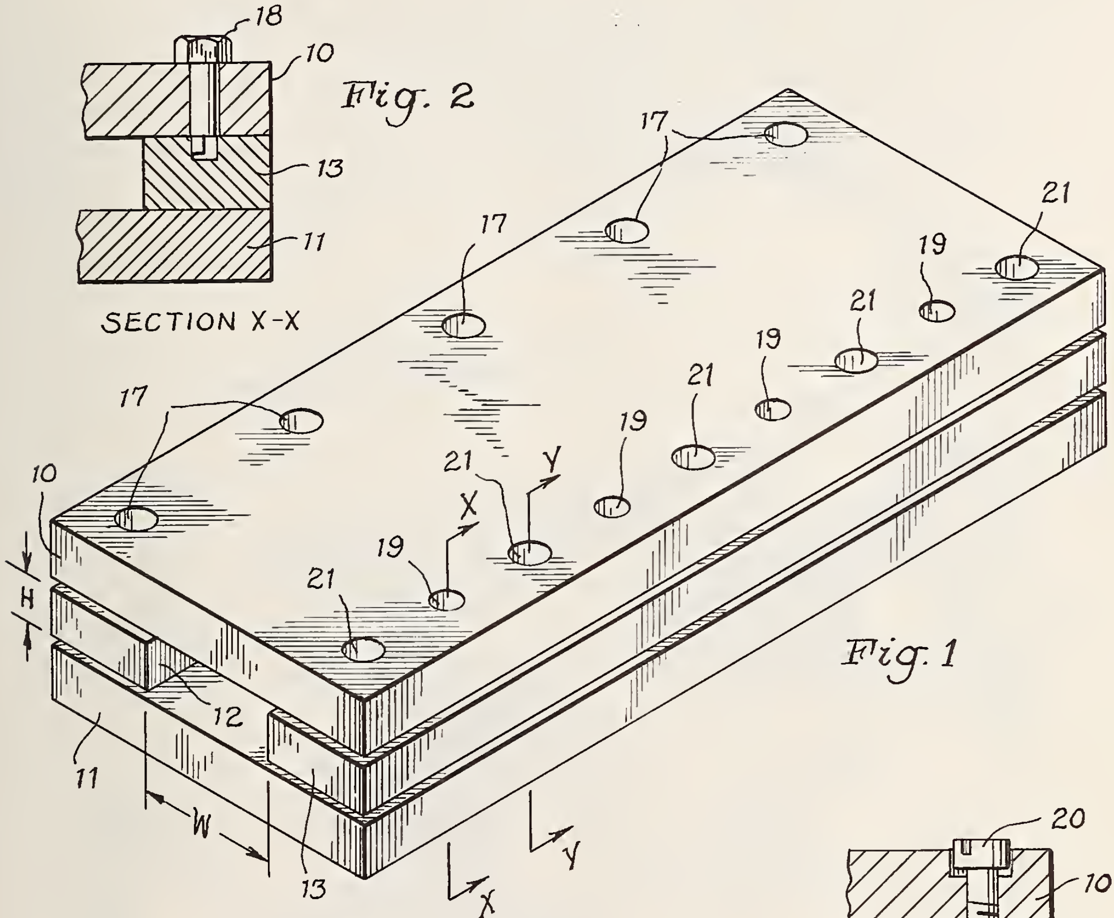
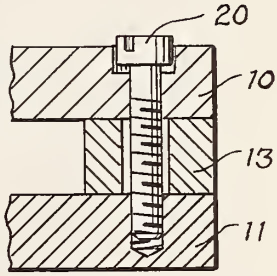


Fig. 2

SECTION X-X

Fig. 1

Fig. 3



SECTION Y-Y

METHOD FOR FABRICATING PRECISION WAVEGUIDE SECTIONS

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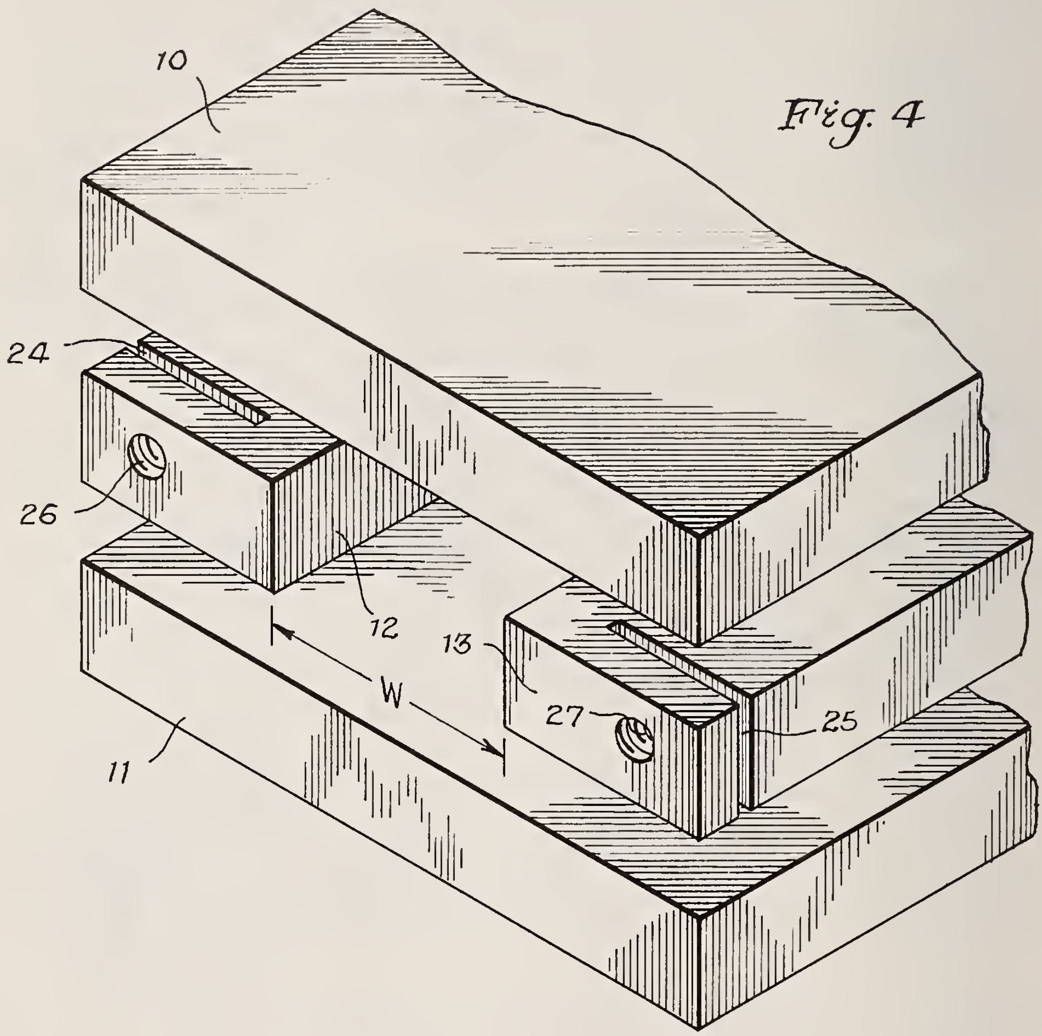
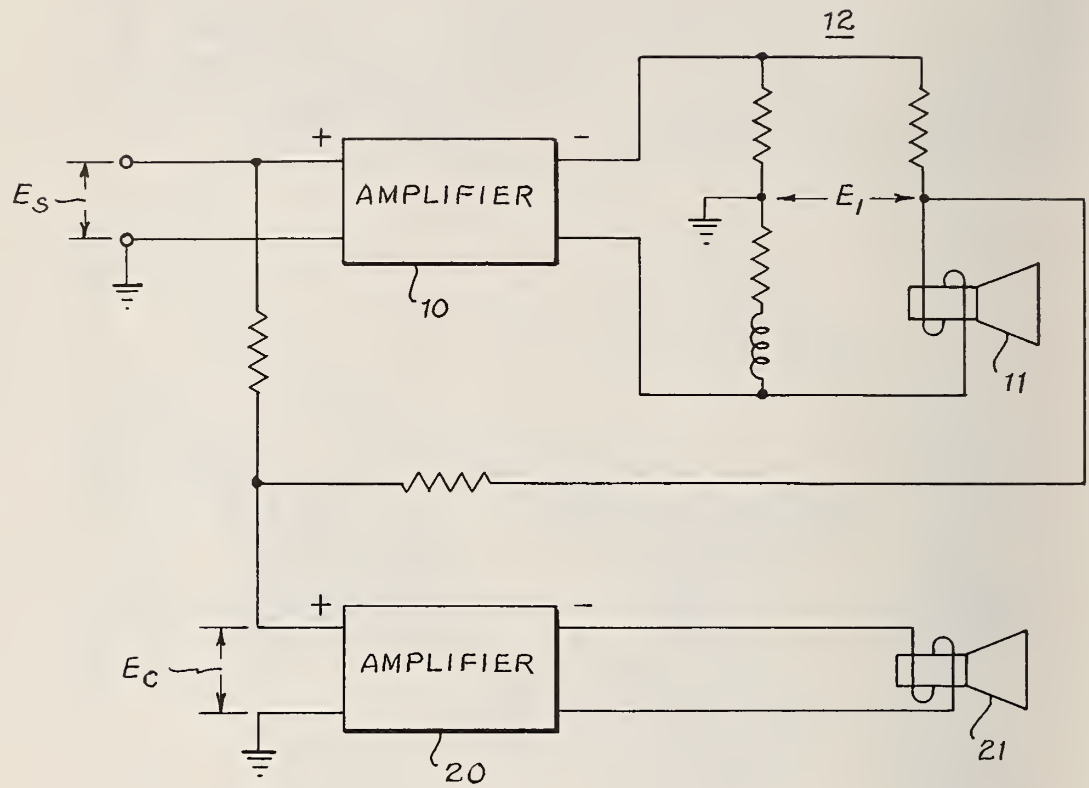


Fig. 4

When necessary, small adjustments to correct for "bell mouthing" are accomplished as follows. With reference to Fig. 4, slots 24 and 25 are cut into bars 12 and 13, and holes 26 and 27 are drilled and tapped. Screws (not shown) are inserted in the holes until they press against the back walls of the related slots. When the screws are tightened the structurally weakened areas at the bottom of the slots act as hinges to reduce the magnitude of dimension W. Correction of dimension H is accomplished by permanently attaching a clamp across bars 10 and 11 at the end of the waveguide.

DISTORTION-CANCELLING LOUDSPEAKER SYSTEM

G. Franklin Montgomery



DISTORTION-CANCELLING LOUDSPEAKER SYSTEM

G. Franklin Montgomery

In the system described here, a loudspeaker is used to compensate for the nonlinear distortion in the sound reproduced in another loudspeaker.

When signal E_s is applied to the input of amplifier 10, the output of 10 drives electrodynamic loudspeaker 11. Signal E_1 is derived from a balanced bridge network 12 and is proportional to the voice coil velocity of loudspeaker 11. Signals E_s and E_1 are subtracted in the input of amplifier 20 to form a correction signal $E_c = E_s - kE_1$, which drives loudspeaker 21 through amplifier 20. The gain of amplifier 20 is made adjustable to permit compensating for any difference in acoustical efficiency between loudspeaker 21 and loudspeaker 11. The factor k is so chosen that for a small signal E_s the correction signal $E_c = 0$. Signal E_c then becomes nonzero only when E_s becomes so large that loudspeaker 11 begins to distort, and loudspeaker 21 produces an acoustic signal which cancels the distortion in the acoustic output of loudspeaker 11.

CRYOGENIC FLUID DENSITY MEASUREMENT SYSTEM

Wallace J. Alspach
Charles E. Miller

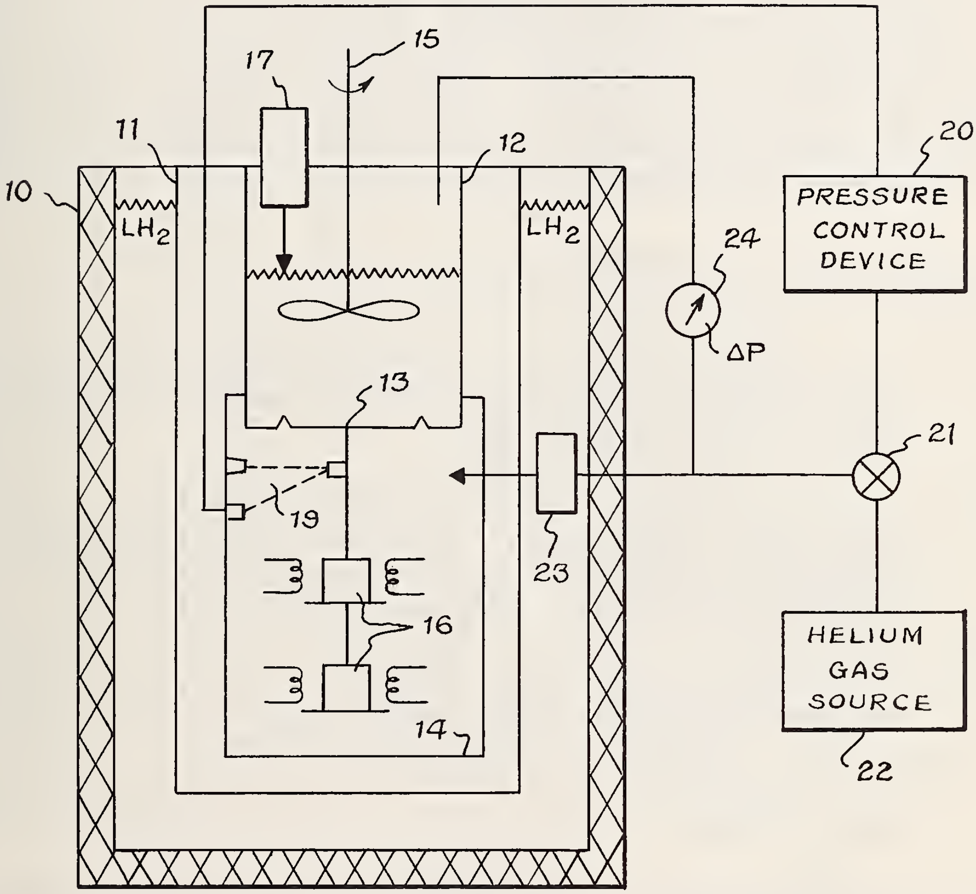
This system may be used to measure the density of cryogenic fluids including the liquid-solid mixtures often referred to as slush cryogens.

For example, in the case of slush hydrogen, liquid hydrogen is contained between the outer insulated tank 10 and the inner tank 11. Weigh tank 12, which includes a flexible bottom member 13, and container 14 are positioned in 11. The fluid in tank 12 is stirred by means of stirrer 15, and calibrated masses 16 are suspended from the flexible member.

The fluid, whose density is to be determined, is contained in tank 12 and its volume is determined with liquid sensor 17. The mass of the fluid, and the mass and pressure of the ullage gas over the fluid, exert a force on flexible member 13, causing it to be displaced from its no load or null position. The displacement is sensed, with masses 16 removed, by photoelectric displacement sensor 19. The output of the sensor is applied to pressure control device 20 which in turn operates valve 21 to allow helium gas to flow from source 22 through heat exchanger 23 to container 14. The gas establishes an opposing force against flexible member 13 in a direction opposite to the displacing force. The magnitude of the opposing force is automatically adjusted by the arrangement just described so that the flexible member is returned to its null position.

CRYOGENIC FLUID DENSITY MEASUREMENT SYSTEM

Wallace J. Alspach
Charles E. Miller



The total force on flexible member 13 is due to the mass of the fluid plus the mass of the ullage gas plus the pressure of the ullage gas. If the mass of the ullage gas is low by comparison to the mass of the fluid, as would be the case when the fluid occupies nearly all the volume of tank 12, then the force on the flexible member is due to the mass of the fluid plus the pressure of the ullage gas. The pressure of the ullage gas is eliminated by differential pressure sensor 24 which is connected on one side to the ullage gas pressure and on the other side to the helium gas pressure. Thus, the output of the sensor is directly related to the mass of the fluid, that is to say, the differential pressure is proportional to the mass of the fluid.

The differential pressure sensor 24 is calibrated as follows:

1. With no fluid contained in weigh tank 12, the pressures exerted on both sides of flexible member 13 are made equal.

2. One of the calibrated masses 16 is suspended from member 13, and the differential pressure necessary to position 13 at its null position is read on sensor 24 and noted.

3. Steps 1 and 2 are repeated with additional mass 16 suspended from member 13.

4. A plot of differential pressure against mass is made.

In a typical operation, the volume of the fluid in weigh tank 12 is determined with liquid sensor 17 and the mass with differential sensor 24. The density of the fluid is then calculated from the relationship $D = \frac{M}{V}$.

CONTROLLED-ATMOSPHERE WEATHERING DEVICE

William F. Brucksch, Jr.*

This device performs accelerated weathering tests on plastic films, elastomers, coatings, or fabrics. The samples are mounted in closed, controlled-atmosphere chambers that may be charged with photoactivators such as sulfur dioxide, ozone, or oxides of nitrogen. The chambers and an arc lamp are suspended in a refrigerated water bath, whereby the samples are maintained at nearly constant temperatures throughout exposure, and temperature differences between dark-pigmented and light-pigmented (or clear) samples are minimized.

As shown in Fig. 1, the refrigerated water bath consists of an insulated container 10, a cooling coil 12, a refrigeration unit 14 for circulating a refrigerant through the coil 12, and a stirrer 16 for stirring the water 18. A xenon or mercury arc lamp 20 and its leads 22 are enclosed in a glass tubular chamber 24 that is suspended in the center of the bath. Surrounding the lamp 20 are sample holders or chambers 26 containing the samples 28 to be tested. Each chamber 26 consists of a flattened glass tube 30, a gas inlet tube 32 for introducing a purge gas, and an elastomeric stopper 36 for admitting the photoactivator, through a needle syringe (not shown). The inlet and outlet tubes 32, 34 are connected to elastomeric tubes 38, 40, which are clamped after the purging operation and before the introduction of the photoactivator.

In some cases it may be desirable to replace the elastomeric tubes 38, 40 and their clamps with glass stopcocks, and to isolate the elastomeric stoppers 36 from the chambers 26 with glass stopcocks. The stopcocks should be lubricated with a fluorinated elastomer grease. The use of this glass apparatus gives more reproducible results.

As shown in Fig. 2, the thin, flat samples 28 are mounted near and parallel to the flattened walls of the glass tubes 30. The tubes 30, only two of which are shown in Fig. 1, are oriented so that the samples face the arc lamp 20.

The capacity of the refrigeration unit 14 should be equal to or slightly greater than the heat generated by the arc lamp 20. If the two are balanced the temperature of the bath will be constant. The refrigerated bath permits the temperature of the sample to be controlled during the test, whereby it is possible to differentiate between reactions caused by light and those caused by heat. The usual overheating of dark-pigmented stocks is minimized. Also, it is possible to mount the samples closer to the arc lamp and thereby shorten the exposure time.

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* Former NBS Research Associate from Manufacturing Chemists' Association, Inc.

CONTROLLED-ATMOSPHERE WEATHERING DEVICE

William F. Brucksch, Jr.

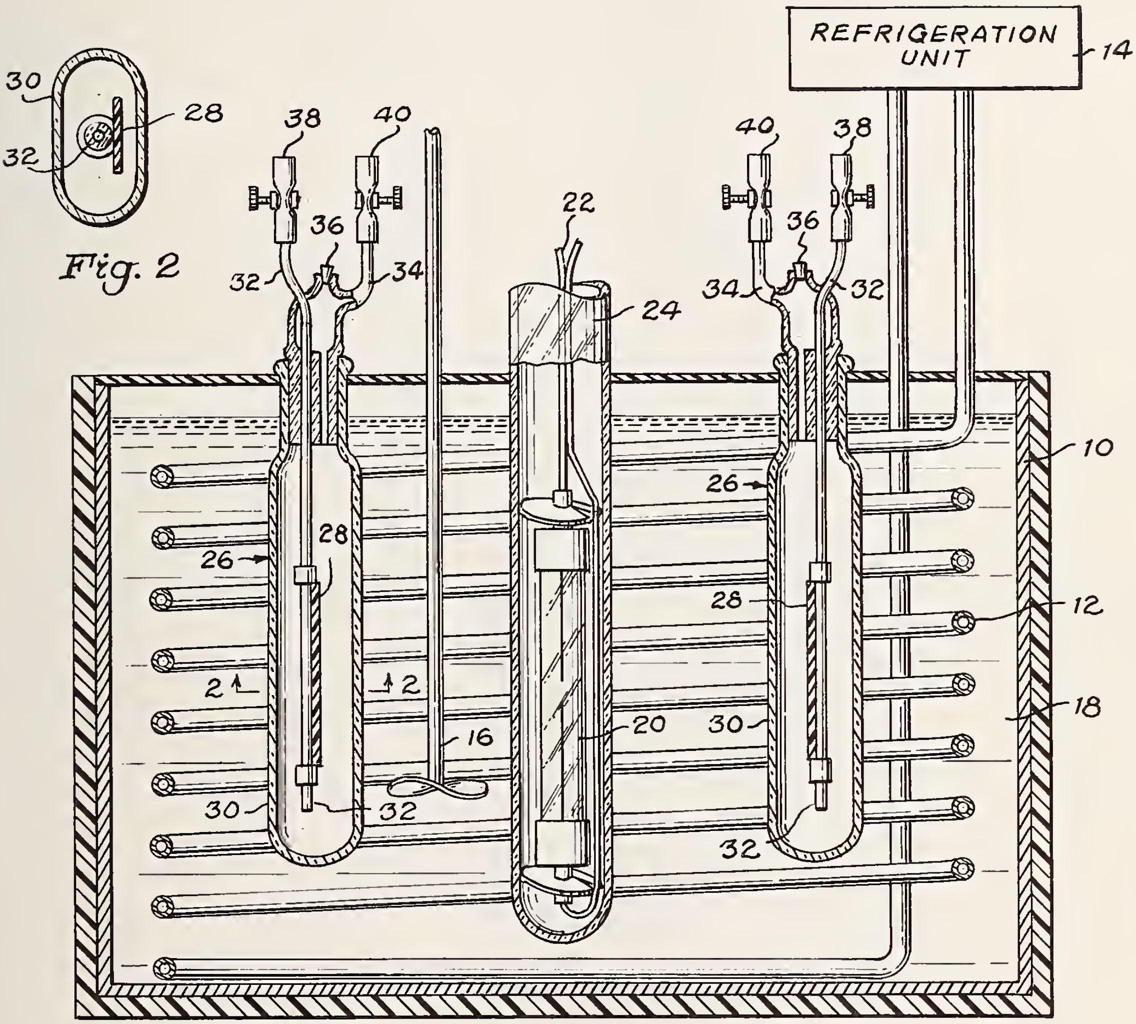

Fig. 1

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