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INTRODUCTION

Several thousand inventions result each year from the aeronautical and space research supported by the National Aeronautics and Space Administration. The inventions having important use in government programs or significant commercial potential are usually patented by NASA. These inventions cover practically all fields of technology and include many that have useful and valuable commercial application.

NASA inventions best serve the interests of the United States when their benefits are available to the public. In many instances, the granting of nonexclusive or exclusive licenses for the practice of these inventions may assist in the accomplishment of this objective. This bibliography is published as a service to companies, firms, and individuals seeking new, licensable products for the commercial market.

The NASA Patent Abstracts Bibliography (NASA PAB) is a semiannual NASA publication containing comprehensive abstracts and indexes of NASA-owned inventions covered by U.S. patents and applications for patent. The citations included in NASA PAB were originally published in NASA's Scientific and Technical Aerospace Reports (STAR) and cover STAR announcements made since May 1969.

For the convenience of the user, each issue of NASA PAB has a separately bound Abstract Section (Section 1) and Index Section (Section 2). Although each Abstract Section covers only the indicated six-month period, the Index Section is cumulative covering all NASA-owned inventions announced in STAR since 1969. Thus a complete set of NASA PAB would consist of the Abstract Sections of Issue 04 (January 1974) and Issue 12 (January 1978) and the Abstract Section for all subsequent issues and the Index Section for the most recent issue.

The 128 citations published in this issue of the Abstract Section cover the period January 1993 through June 1993. The Index Section references over 5400 citations covering the period May 1969 through June 1993.

ABSTRACT SECTION (SECTION 1)

This PAB issue includes 10 major subject divisions separated into 76 specific categories and one general category/division. (See Table of Contents for the scope note of each category, under which are grouped appropriate NASA inventions.) This scheme was devised in 1975 and revised in 1987 in lieu of the 34 category divisions which were utilized in PAB supplements (01) through (06) covering STAR abstracts from May 1969 through January 1974. Each entry in the Abstract Section consists of a STAR citation accompanied by an abstract and, when appropriate, a key illustration taken from the patent or application for patent. Entries are arranged by subject category in order of the ascending NASA Accession Number originally assigned for STAR to the invention. The range of NASA Accession Numbers within each issue is printed on the inside front cover.

Abstract Citation Data Elements: Each of the abstract citations has several data elements useful for identification and indexing purposes, as follows:

- NASA Accession Number
- NASA Case Number
- Inventor's Name
- Title of Invention
- U.S. Patent Application Serial Number
- U.S. Patent Number (for issued patents only)
- U.S. Patent Office Classification Number(s) (for issued patents only)

These data elements are identified in the Typical Citation and Abstract and in the indexes.
INDEX SECTION (SECTION 2)

The Index Section is divided into five indexes. These indexes are cross-indexed and are used to locate a single invention or groups of inventions.

**Subject Index:** Lists all inventions according to appropriate alphabetized technical term and indicates the related NASA Case Number, the Subject Category Number, and the Accession Number.

**Inventor Index:** Lists all inventions according to alphabetized names of inventors and indicates the related NASA Case Number, the Subject Category Number, and the Accession Number.

**Source Index:** Lists all inventions according to alphabetized source of invention (i.e., name of contractor or government installation where invention was made) and indicates the related NASA Case Number, the Subject Category Number, and the Accession Number.

**Number Index:** Lists inventions in order of ascending (1) NASA Case Number, (2) U.S. Patent Application Serial Number, (3) U.S. Patent Classification Number, and (4) U.S. Patent Number and indicates the related Subject Category Number and the Accession Number.

**Accession Number Index:** Lists all inventions in order of ascending Accession Number and indicates the related Subject Category Number, the NASA Case Number, the U.S. Patent Application Serial Number, the U.S. Patent Classification Number, and the U.S. Patent Number.

HOW TO USE THIS PUBLICATION TO IDENTIFY NASA INVENTIONS

To identify one or more NASA inventions within a specific technical field or subject, several techniques are possible with the flexibility incorporated into the *NASA PAB.*

1. **Using Subject Category:** To identify all NASA inventions in any one of the subject categories in this issue of *NASA PAB,* select the desired Subject Category in the Abstract Section (Section 1) and find the inventions abstracted thereunder.

2. **Using Subject Index:** To identify all NASA inventions listed under a desired technical subject index term, (A) turn to the cumulative Subject Index in the Index Section and find the invention(s) listed under the desired technical subject term. (B) Note the indicated Accession Number and the Subject Category Number. (C) Using the indicated Accession Number, turn to the inside front cover of the Index Section to determine which issue of the Abstract Section includes the Accession Number desired. (D) To find the abstract of the particular invention in the issue of the Abstract Section selected, (1) use the Subject Category Number to locate the Subject Category and (2) use the Accession Number to locate the desired invention within the Subject Category listing.

3. **Using Patent Classification Index:** To identify all inventions covered by issued NASA patents (not including applications for patent) within a desired Patent Classification, (A) turn to the Patent Classification Number in the Number Index of Section 2 and find the associated invention(s), and (B) follow the instructions outlined in (2)(B), and (D) above.
TYPICAL CITATION AND ABSTRACT

An apparatus, system, and method for non-destructible evaluation (NDE) of a material use thermography to rapidly detect and/or generally locate a feature such as, for example, damage or a defect in the material. The apparatus, system, and method also use ultrasound to specifically locate the feature in the material for quantification and/or evaluation either by an operator or by an external device suited for such purpose. Accordingly, the apparatus, system and method are particularly useful for NDE in applications such as the analysis of the structure of an aircraft, for example, in which the scale of the material to be analyzed is large, thus requiring the rapid NDE afforded by thermography, and in which quantification and/or evaluation of a feature must be performed with precision, thus requiring the relatively high-resolution NDE afforded by ultrasound.

NASA
# TABLE OF CONTENTS

## Section 1 • Abstracts

### AERONAUTICS  
For related information see also Astronautics.

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<td>AERONAUTICS (GENERAL)</td>
<td>N.A.</td>
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<td>02</td>
<td>AERODYNAMICS</td>
<td>Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also 34 Fluid Mechanics and Heat Transfer.</td>
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<td>03</td>
<td>AIR TRANSPORTATION AND SAFETY</td>
<td>N.A. Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also 16 Space Transportation and 85 Urban Technology and Transportation.</td>
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<td>04</td>
<td>AIRCRAFT COMMUNICATIONS AND NAVIGATION</td>
<td>N.A. Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 17 Space Communications, Spacecraft Communications, Command and Tracking and 32 Communications and Radar.</td>
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<td>05</td>
<td>AIRCRAFT DESIGN, TESTING AND PERFORMANCE</td>
<td>N.A. Includes aircraft simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Urban Technology and Transportation.</td>
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<td>06</td>
<td>AIRCRAFT INSTRUMENTATION</td>
<td>Includes cockpit and cabin display devices; and flight instruments. For related information see also 19 Spacecraft Instrumentation and 35 Instrumentation and Photography.</td>
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<td>07</td>
<td>AIRCRAFT PROPULSION AND POWER</td>
<td>N.A. Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.</td>
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<td>08</td>
<td>AIRCRAFT STABILITY AND CONTROL</td>
<td>N.A. Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also 05 Aircraft Design, Testing and Performance.</td>
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<td>09</td>
<td>RESEARCH AND SUPPORT FACILITIES (AIR)</td>
<td>Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also 14 Ground Support Systems and Facilities (Space).</td>
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### ASTRONAUTICS  
For related information see also Aeronautics.

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<td>ASTRONAUTICS (GENERAL)</td>
<td>N.A. For extraterrestrial exploration see 91 Lunar and Planetary Exploration.</td>
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<td>13</td>
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<td>GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)</td>
<td>N.A. Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. For related information see also 09 Research and Support Facilities (Air).</td>
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<td>LAUNCH VEHICLES AND SPACE VEHICLES</td>
<td>N.A. Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also 20 Spacecraft Propulsion and Power.</td>
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<td>SPACE TRANSPORTATION</td>
<td>N.A. Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also 03 Air Transportation and Safety and 18 Spacecraft Design, Testing and Performance. For space suits see 54 Man/System Technology and Life Support.</td>
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<td>SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING</td>
<td>N.A. Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout. For related information see also 04 Aircraft Communications and Navigation and 32 Communications and Radar.</td>
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N.A.—no abstracts were assigned to this category for this issue.
18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE .................................................. 2
Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see 54 Man/System Technology and Life Support. For related information see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation.

19 SPACECRAFT INSTRUMENTATION ................................................................. N.A.
For related information see also 06 Aircraft Instrumentation and 35 Instrumentation and Photography.

20 SPACECRAFT PROPULSION AND POWER .................................................. 3
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also 07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion, and 15 Launch Vehicles and Space Vehicles.

CHEMISTRY AND MATERIALS

23 CHEMISTRY AND MATERIALS (GENERAL) ................................................. N.A.

24 COMPOSITE MATERIALS ................................................................. 4
Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see 27 Nonmetallic Materials.

25 INORGANIC AND PHYSICAL CHEMISTRY .................................................. 5
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also 77 Thermodynamics and Statistical Physics.

26 METALLIC MATERIALS ................................................................. 5
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS ................................................................. 6
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.

28 PROPPELLANTS AND FUELS ................................................................. 7
Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.

29 MATERIALS PROCESSING ................................................................. N.A.
Includes space-based development of products and processes for commercial application. For biological materials see 55 Space Biology.

ENGINEERING For related information see also Physics.

31 ENGINEERING (GENERAL) ................................................................. 8
Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR ................................................................. 9
Includes radar; land and global communications; communications theory; and optical communications. For related information see also 04 Aircraft Communications and Navigation and 17 Space Communications, Spacecraft Communications, Command and Tracking. For search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation.

33 ELECTRONICS AND ELECTRICAL ENGINEERING .................................................. 9
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also 60 Computer Operations and Hardware and 76 Solid-State Physics.

34 FLUID MECHANICS AND HEAT TRANSFER .................................................. 12
Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also 02 Aerodynamics and 77 Thermodynamics and Statistical Physics.

35 INSTRUMENTATION AND PHOTOGRAPHY ............................................. 13
Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Aircraft Instrumentation and 19 Spacecraft Instrumentation.

36 LASERS AND MASERS ................................................................. 17
Includes parametric amplifiers. For related information see also 76 Solid-State Physics.
37 MECHANICAL ENGINEERING
Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY
Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS
Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

GEOSCIENCES
For related information see also Space Sciences.

42 GEOSCIENCES (GENERAL)

43 EARTH RESOURCES AND REMOTE SENSING
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see 35 Instrumentation and Photography.

44 ENERGY PRODUCTION AND CONVERSION
Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 26 Propellants and Fuels.

45 ENVIRONMENT POLLUTION
Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see 93 Space Radiation.

47 METEOROLOGY AND CLIMATOLOGY
Includes weather forecasting and modification.

48 OCEANOGRAPHY
Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also 43 Earth Resources and Remote Sensing.

LIFE SCIENCES

51 LIFE SCIENCES (GENERAL)

52 AEROSPACE MEDICINE
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.

55 SPACE BIOLOGY
Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

60 COMPUTER OPERATIONS AND HARDWARE
Includes hardware for computer graphics, firmware, and data processing. For components see 33 Electronics and Electrical Engineering.

61 COMPUTER PROGRAMMING AND SOFTWARE
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS
Includes computer networks and special application computer systems.
63 CYBERNETICS
Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also 54 Man/System Technology and Life Support.

64 NUMERICAL ANALYSIS
Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS
Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS
Includes topology and number theory.

PHYSICS For related information see also Engineering.

70 PHYSICS (GENERAL)
For precision time and time interval (PTTI) see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.

71 ACOUSTICS
Includes sound generation, transmission, and attenuation. For noise pollution see 45 Environment Pollution.

72 ATOMIC AND MOLECULAR PHYSICS
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS
Includes elementary and nuclear particles; and reactor theory. For space radiation see 93 Space Radiation.

74 OPTICS
Includes light phenomena and optical devices. For lasers see 36 Lasers and Masers.

75 PLASMA PHYSICS
Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.

76 SOLID-STATE PHYSICS
Includes superconductivity. For related information see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

77 THERMODYNAMICS AND STATISTICAL PHYSICS
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also 25 Inorganic and Physical Chemistry and 34 Fluid Mechanics and Heat Transfer.

SOCIAL SCIENCES

80 SOCIAL SCIENCES (GENERAL)
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.

83 ECONOMICS AND COST ANALYSIS
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see 03 Air Transportation and Safety, 16 Space Transportation, and 44 Energy Production and Conversion.
SPACE SCIENCES  For related information see also Geosciences.

88 SPACE SCIENCES (GENERAL) ................................................................. N.A.

89 ASTRONOMY .................................................................................. N.A.
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS ........................................................................... N.A.
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also 75 Plasma Physics.

91 LUNAR AND PLANETARY EXPLORATION ............................................. N.A.
Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.

92 SOLAR PHYSICS ........................................................................ N.A.
Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.

93 SPACE RADIATION ........................................................................ N.A.
Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see 52 Aerospace Medicine. For theory see 73 Nuclear and High-Energy Physics.

GENERAL
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL ..................................................................................... N.A.

Section 2 • Indexes

SUBJECT INDEX
INVENTOR INDEX
SOURCE INDEX

CONTRACT NUMBER INDEX
NUMBER INDEX
ACCESSION NUMBER INDEX
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

BOUNDARY LAYER RELAMINARIZATION DEVICE Patent Application

THEODORE R. CREEL, inventor (to NASA) 7 Jan. 1992 13 p

Relamination of a boundary layer formed in supersonic flow over the leading edge of a swept airfoil is accomplished by means of at least one band, especially a quadrangular band, and most preferably a square band. Each band conforms to the leading edge and the upper and lower surfaces of the airfoil as an integral part thereof and extends perpendicularly from the leading edge. Each band has a height of about two times the thickness of the maximum expected boundary layer.

REFLECTION TYPE SKIN FRICTION METER Patent


A housing block is provided having an upper surface conforming to the test surface of a model or aircraft. An oil film is supplied upstream of a transparent wedge window located in this upper surface by an oil pump system located external to the housing block. A light source located within the housing block supplies a light beam which passes through this transparent window and is reflected back through the transparent window by the upper surface of the oil film to a photo-sensitive position sensor located within the housing. This position sensor allows the slope history of the oil film caused by and aerodynamic flow to be determined. The skin friction is determined from this slope history. Internally located mirrors augment and

UNDERWING COMPRESSION VORTEX ATTENUATION DEVICE Patent Application

JAMES C. PATTERSON, inventor (to NASA) 22 May 1992 7 p

A vortex attenuation device is presented which dissipates a lift-induced vortex generated by a lifting aircraft wing. The device consists of a positive pressure gradient producing means in the form of a compression panel attached to the lower surface of the wing and facing perpendicular to the airflow across the wing. The panel is located between the midpoint of the local wing cord and the trailing edge in the chord-wise direction and at a point which is approximately 55 percent of the wing span as measured from the fuselage center line in the spanwise direction. When deployed in flight, this panel produces a positive pressure gradient aligned with the final roll-up of the total vortex system which interrupts the axial flow in the vortex core and causes the vortex to collapse.
06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

N93-19023# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

STALL DEPARTURE RESISTANCE ENHANCER Patent Application

A stall departure resistance enhancer for an aircraft for controlling flow separation by inducing vortical flow over the upper surface of the wing is described. A flat triangular plate is secured to a leading edge of the wing to reduce drag, and the tip of the triangular plate is sharp and the edges are thin and sharp to induce good vortical flow. The thickness of the plate is minimal, but it is sufficient so that the plate remains rigid for all angles of attack. A tip of the triangular plate protrudes forward from the leading edge of the wing, and the centerline of the triangular plate extending through the tip is aligned in the freestream direction. In a second embodiment, the triangular plate is hingedly secured to the leading edge of the wing, and a stop is provided to limit the hinged movement of the plate at or near the stall angle of attack.

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

N93-11057# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

METHOD OF REMOTELY CHARACTERIZING THERMAL PROPERTIES OF A SAMPLE Patent

A sample in a wind tunnel is radiated from a thermal energy source outside of the wind tunnel. A thermal imager system, also located outside of the wind tunnel, reads surface radiations from the sample as a function of time. The produced thermal images are characteristic of the heat transferred from the sample to the flow across the sample. In turn, the measured rates of heat loss of the sample are characteristic of the flow and the sample.

Official Gazette of the U.S. Patent and Trademark Office

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

N93-17061# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PRESSURE WALL PATCH Patent Application

A rigid patch body for placing over a damaged portion (hole) of an external wall of a pressurized vessel, such as a space vehicle or a habitat, is discussed. The rigid patch body allows an astronaut to make temporary repairs to the pressurized vessel from the exterior of the vessel, which enables more permanent repairs to be made from the interior of the vessel. The pressure wall patch of the present invention includes a floor surrounded by four side members. Each side member includes a threaded screw for anchoring the patch body to the external wall of the pressurized vessel and a recess in its lower surface for supporting an inflatable bladder for surrounding the damaged portion (hole) of the external wall to seal the area.
repressurized. The floor of the rigid patch body supports a source of gas that is connected to the gas supply valve and a gas supply gauge in communication with the gas supply valve and the inflatable bladder.

**20 RESEARCH AND SUPPORT FACILITIES (AIR)**

N93-17412# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SUBSTITUTED 1,1,1-TRIARYL 2,2,2-TRIFLUOROETHANES AND PROCESSES FOR THEIR SYNTHESIS Patent Application

WILLIAM B. ALSTON, inventor (to NASA) and ROY F. GRATZ, inventor (to NASA) 27 Nov. 1992 23 p


Synthetic procedures to tetraalkyls, tetraacids, and dianhydrides substituted 1,1,1-triaryl 2,2,2-trifluoroethanes which comprises: (1) 1,1-bis(dialkylaryl) 1-aryl-2,2,2-trifluoroethane, (2) 1,1-bis(dicarboxyaryl) 1-aryl-2,2,2-trifluoroethane, or (3) cyclic dianhydride or diamine of 1,1-bis(dialkylaryl) 1-aryl-2,2,2-trifluoroethanes. The synthesis of (1) is accomplished by the condensation reaction of an aryltrifluoromethyl ketone with a dialkylaryl compound. The synthesis of (2) is accomplished by oxidation of (1). The synthesis dianhydride of (3) is accomplished by the conversion of (2) to its corresponding cyclic dianhydride. The synthesis of the diamine is accomplished by the similar reaction of an aryltrifluoromethyl ketone with an aniline or alkyl substituted or disubstituted anilines. Also, other derivatives of the above are formed by nucleophilic displacement reactions.

**20 SPACECRAFT PROPULSION AND POWER**

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

N93-18656* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SPECTROSCOPIC WEAR DETECTOR Patent


The elemental composition of a material exposed to hot gases and subjected to wear is determined. Atoms of an elemental species not appearing in this material are implanted in a surface at a depth based on the maximum allowable wear. The exhaust gases are spectroscopically monitored to determine the exposure of these atoms when the maximum allowable wear is reached.

Official Gazette of the U.S. Patent and Trademark Office

N93-18283* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

POLY(1,2,4-TRIAZOLE) VIA AROMATIC NUCLEOPHILIC DISPLACEMENT Patent


The primary object of this invention constitutes new compositions of matter and a new process to prepare poly(1,2,4-triazoles) (PT). It concerns new PT, novel monomers, and the process for preparing the same. Another object of the present invention is to provide new PT that are useful as composite matrix resins for aircraft
and dielectric interlayers in electronic devices. Another object of the present invention is the composition of several new di(hydroxyphenyl)-1,2,4-triazole monomers. According to the foregoing and additional objects were obtained by synthesizing PT by the nucleophilic displacement reaction of di(hydroxyphenyl)-1,2,4-triazole monomers with activated aromatic dihalides. The inherent viscosities of the PT ranged from 1.37 to 3.4 dL/g and the glass transition temperatures ranged from 210 to 216 C. One polymer exhibited a crystalline melting temperature of 377 C. Thermogravimetric analysis (TGA) showed no weight loss occurring below 300 C in air or nitrogen with a 5 percent weight loss occurring at approximately 500 C in air and nitrogen. The synthesis of the di(hydroxyphenyl)-1,2,4-triazole monomer is represented in an equation. The monomer can be prepared by either of the two routes shown. The chemistry can easily be extended to prepare similar di(hydroxyphenyl)-1,2,4-triazole monomers. The aromatic dihydrazides in some cases are commercially available or readily prepared from hydrazine and a di(acid chloride). The substitution of the hydroxy groups in either type of monomer may be meta-meta, para-para, or para-meta. The general reaction sequence of PT from each type of di(hydroxyphenyl)-1,2,4-triazole monomer is shown.

Official Gazette of the U.S. Patent and Trademark Office

N93-11543* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SILICON CARBIDE FIBER REINFORCED STRONTIUM ALUMINOSILICATE GLASS-CERAMIC MATRIX COMPOSITE Patent Application

A SrO-AI2O3 - 2SrO2 (SAS) glass ceramic matrix is reinforced with CVD SiC continuous fibers. This material is prepared by casting a slurry of SAS glass powder into tapes. Mats of continuous CVD-SiC fibers are alternately stacked with the matrix tapes. This tape-mat stack is warm-pressed to produce a 'green' composite. The remaining interim material is hot pressed.

NASA

N93-13416* National Aeronautics and Space Administration.

METHOD OF APPLYING A THERMAL BARRIER COATING SYSTEM TO A SUBSTRATE Patent


A metallic close-out layer is applied to the surface of a thermal barrier coating system to seal the ceramic material in the coating. The close-out layer is glass-bead preened to densify the surface.

SANDWICHED STRUCTURAL PANEL HAVING A BI-DIRECTIONAL CORE STRUCTURE Patent Application


A structural panel assembly has a bi-directional core structure sandwiched between and secured to a pair of outer side wall members. The core structure is formed from first and second perpendicular series of elongated strip members having crenelated configurations. The strip members in the first series thereof are transversely interwoven with the strip members in the second series thereof in a manner such that crest portions of the strip members in the first series overlie and oppose trough portions of the strip members in the second series, and trough portions of the strip members in the first series underlie and oppose crest portions of the strip members in the second series. The crest portions of all of the strip members lie generally in a first plane and are secured to the inner side of one of the panel assembly outer side walls, and the trough portions of all of the strip members lie generally in a second plane and are secured to the inner side of the other panel assembly outer side wall.

HIGH TEMPERATURE SORBENTS FOR OXYGEN Patent Application


A sorbent capable of removing trace amounts of oxygen (ppt) from a gas stream at a high temperature above 200 °C comprising a porous alumina silicate support such as zeolite containing from 1 to 10 percent by weight of ion exchanged transition metal such as copper or cobalt ions and 0.05 to 1.0 percent by weight of an activator selected from a platinum group metal such as platinum is described. The activation temperature, oxygen sorption, and reducibility are all improved by the presence of the platinum activator.

METHOD OF CHARACTERIZING RESIDUAL STRESS IN FERROMAGNETIC MATERIALS USING A PULSE HISTOGRAM OF ACOUSTIC EMISSION SIGNALS Patent


The invention is a method and apparatus for characterizing residual uniaxial stress in a ferromagnetic test member by distinguishing between residual stresses resulting from positive (tension) forces and negative (compression) forces by using the distinct and

INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.
NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N93-11059* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A process for making a semi-interpenetrating polymer network which includes a high performance thermosetting polyimide having a nadic end group acting as a crosslinking site and a high performance linear thermoplastic polyimide is disclosed. Provided is an improved high temperature matrix resin which is capable of performing at 316 C in air for several hundreds of hours. This resin has significantly improved toughness and microcracking resistance, excellent processability and mechanical performance, and cost effectiveness.

Official Gazette of the U.S. Patent and Trademark Office

N93-11912# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A thin, light-weight, multi-layer coating is provided for protecting metals and their alloys from environmental attack at high temperatures. A reaction barrier is applied to the metal substrate and a diffusion barrier is then applied to the reaction barrier. A sealant layer may also be applied to the diffusion barrier if desired. The reaction barrier is either non-reactive or passivating with respect to the metal substrate and the diffusion barrier. The diffusion barrier is either non-reactive or passivating with respect to the reaction barrier and the sealant layer. The sealant layer is immiscible with the diffusion barrier and has a softening point below the expected use temperature of the metal.

N93-17062# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SINTERING SILICON NITRIDE Patent Application N. P. BANSAL, inventor (to NASA), S. R. LEVINE, inventor (to NASA), and W. A. SANDERS, inventor (to NASA) 27 Nov. 1992 7p
Oxides having a composition of (Ba(1-x)Sr(x))O-Al2O3-2SiO2 are used as sintering aids for producing an improved silicon nitride ceramic material. The x must be greater than 0 to insure the formation of the stable monoclinic celsian glass phase.

A low thermal expansion oxidation resistant coating utilizes an oxidation resistant alloy and an inert low thermal expansion phase which act to reduce overall thermal expansion. This coating is applied to a low thermal expansion substrate.

Thermally stable, glassy polymeric materials were prepared from maleimide-acetylene terminated monomeric materials by several methods. The monomers were heated to self-polymerize. The AB structure of the monomer allowed it to polymerize with either bismaleimide monomers/oligomers or bis-acetylene monomers/oligomers. Copolymerization can also take place by mixing bismaleimide and bisacetylene monomers/oligomers with the maleimide-acetylene terminated monomers to yield homogenous glassy polymers.

Common blasting caps are made from an aluminum shell in the form of a tube which is closed at both ends. One end, which is called the output end, terminates in a principal side or face, and contains a detonating agent which communicates with a means for igniting the blast.
detonating agent. The improvement of the present invention is a flat, steel foil bonded to the face in a position which is aligned perpendicularly to the longitudinal axis of the tube.

The number of fixtures (or holding devices) and reorientations required for assembly, through the analysis of stability, directionality, and manipulability. All these factors are used in defining cost and heuristic functions for an AO* search for an optimal plan.
INTEGRAL FILL YARN INSERTION AND BEATUP METHOD USING INFLATABLE MEMBRANE Patent


An apparatus and method for integral fill yarn insertion and beatup are disclosed. A modified rapier contains a channel for holding fill yarn. The channel is covered with a flexible and inflatable boot, and an inflating apparatus for this boot is also attached. Fill yarn is inserted into the channel, and the rapier is extended into a shed formed by warp yarn. Next, the rapier is pushed into the fell of the fabric, and the flexible and inflatable cover inflated, which both pushes the yarn into the fell of the fabric and performs beatup. The rapier is withdrawn and the shed closed to complete one step of the weaving process.

METHOD AND APPARATUS FOR THREE DIMENSIONAL BRAIDING Patent Application


A machine for three-dimensional braiding of fibers is provided in which carrier members travel on a curved, segmented and movable braiding surface. The carrier members are capable of independent, self-propelled motion along the braiding surface. Carrier member position on the braiding surface is controlled and monitored by computer. Also disclosed is a yarn take-up device capable of maintaining tension in the braiding fiber.

COMPOSITE VIDEO AND GRAPHICS DISPLAY FOR CAMERA VIEWING SYSTEMS IN ROBOTICS AND TELEOPERATION Patent


A system for real-time video image display for robotics or remote-vehicle teleoperation is described that has at least one robot arm or remotely operated vehicle controlled by an operator through hand-controllers, and one or more television cameras and optional lighting elements. The system has at least one television monitor for display of a television image from a selected camera and the ability to select one of the cameras for image display. Graphics are generated with icons of cameras and lighting elements for display surrounding the television image to provide the operator information on: the location and orientation of each camera and lighting element; the region of illumination of each lighting element; the viewed region and range of focus of each camera; which camera is currently selected for image display for each monitor; and when the controller coordinate for said robot arms or remotely operated vehicles have been transformed to correspond to coordinates of a selected or nonselected camera.

ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

N93-11456*# National Aeronautics and Space Administration. Pasadena Office, CA.
OVERCHARGE AND OVERDISCHARGE PROTECTION OF AMBIENT TEMPERATURE SECONDARY LITHIUM CELLS

Patent Application


A cathode additive is provided for protecting an ambient temperature secondary lithium cell from overcharging or overdischarging. The cathode additive is chosen to create an upper voltage plateau which is slightly higher than a characteristic charge cutoff voltage of the cathode of the cell. The cathode additive additionally creates a lower voltage plateau which is slightly lower than the characteristic discharge cutoff voltage of the cell. Preferably, the cathode additive is a transition metal oxide or a sulfide and may, for example, include a mixture of Li2Mn2O4 and Li(0.1)MoO2.

ENHANCED FATIGUE AND RETENTION IN FERROELECTRIC THIN FILM MEMORY CAPACITORS BY POST-TOP ELECTRODE ANNEAL TREATMENT Patent Application
SARITA THAKOOR, inventor (to NASA) 20 Oct. 1992 23 p

Thin film ferroelectric capacitors comprising a ferroelectric film sandwiched between electrodes for nonvolatile memory operations are rendered more stable by subjecting the capacitors to an anneal following deposition of the top electrode. The anneal is done so as to form the interface between the ferroelectric film and the top electrode. Heating in an air oven, laser annealing, or electron bombardment may be used to form the interface. Heating in an air oven is done at a temperature at least equal to the crystallization temperature of the ferroelectric film. Where the ferroelectric film comprises lead zirconate titanate, annealing is done at about 550 to 600°C for about 10 to 15 minutes. The formation treatment reduces the magnitude of charge associated with the nonswitching pulse in the thin film ferroelectric capacitors. Reduction of this charge leads to significantly more stable nonvolatile memory operations in both digital and analog memory devices. The formation treatment also reduces the ratio of change of the charge associated with the nonswitching pulse as a function of retention time. These improved memory devices exhibit greater performance in retention and reduced fatigue in memory arrays.

HIGH ENERGY AND HIGH POWER DENSITY ULTRACAPACITORS AND SUPERCAPACITORS Patent Application
CAROL R. LEWIS, inventor (to NASA) and SHIAO-PING S. YEN, inventor (to NASA) 29 Sep. 1992 24 p

Ultracapacitor and supercapacitor designs wherein two discrete metal film current collectors of the prior art, one for each of the cathode and anode, are replaced by a single thin polymer film. The polymer film is typically several microns thick and metallized on both sides. The thickness of the metallization is varied from several hundred to several thousand Angstroms depending upon the particular application. This metallization serves as the positive and negative electrodes (current collectors) which are spatially separated by the polymer dielectric film. The resulting reduction of volume increases the volumetric energy density and the reduction of mass increases the gravimetric energy density. The electrolyte solvent/salt system can be selected to provide useful individual cell voltages as high as 5 volts. The voltage is limited only by the electrolytic stability of the solvent and salt. Ultracapacitors fabricated in accordance with the present invention may have energy densities exceeding 10 watt-hours per kilogram and volumetric energy densities exceeding 15 watt-hours per liter. Values which are yet higher are feasible with supercapacitors fabricated in accordance with the present invention.

An ambient room temperature, high density, rechargeable lithium battery includes a Li(x)Mg2Si negative anode which intercalates lithium to form a single crystalline phase when x is up to 1.0 and an amorphous phase when x is from 1 to 2.0. The electrode has good reversibility and mechanical strength after cycling.
interference. Since the coated substrate need only be heated for evaporation and curing at relatively low temperatures compared to firing, the superconducting coating can be applied to a wide variety of different materials.

**FLUID MECHANICS AND HEAT TRANSFER**

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

**SYSTEM AND METHOD FOR CANCELLING EXPANSION WAVES IN A WAVE ROTOR Patent Application**


A wave rotor system that is comprised of a wave rotor coupled to first and second plates is described. Special ports are provided, one in each of the first and second end plates, to cancel expansion waves generated by the release of working fluid from the wave rotor. One of the expansion waves is reflected in the wave rotor from a reflecting portion and provided to the special port in the second end plate. Fluid present at the special port in the second end plate has a stagnation pressure and mass flow which is the same as that of the cells of the wave rotor communicating with such special port. This allows for cancellation of the expansion wave generated by the release of working fluid from the wave rotor. The special port in the second end plate has a first end corresponding to the head of the expansion wave and a second end corresponding to the tail of the expansion wave. Also, the special port is configured to continually change along the circumference of the second end plate to affect expansion wave cancellation. An expansion wave generated by a second release of working fluid from the wave rotor is cancelled in a similar manner to that described above using a special port in the first end plate. The cycle of operation of the wave rotor system is designed so that the stagnation pressure and mass flow of the fluid present at the special ports is the same so that the special ports may be connected by a common duct.

**FLUID SEPARATOR Patent Application**


A fluid separator for separating particulate matter such as contaminates is provided which includes a series of spiral tubes of progressively decreasing cross sectional area connected in series. Each tube has an outlet on the outer curvature of the spiral. As fluid spirals down a tube, centrifugal force acts to force the heavier
particulate matter to the outer wall of the tube, where it exits through the outlet. The remaining, and now cleaner, fluid reaches the next tube, which is smaller in cross sectional area, where the process is repeated. The fluid which comes out the final tube is diminished of particulate matter.

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.


A device for measuring strain in substrates at high temperatures, in which the thermally induced apparent strain is nulled, is presented. Two gages are used: one active gage and one compensating gage. Both gages are placed on the substrate to be gaged; the active gage is attached such that it responds to mechanical and thermally induced apparent strain while the compensating gage is attached such that it does not respond to mechanical strain and measures only thermally induced apparent strain. A thermal blanket is placed over the two gages to maintain the gages at the same temperature. The two gages are wired as adjacent arms of a Wheatstone bridge which nulls the thermally induced apparent strain giving a true reading of the mechanical strain in the substrate.


The invention is a method of forming a multiple layer dielectric for use in a hot-film laminar separation sensor. The multiple layer dielectric substrate is formed by depositing a first layer of a thermoplastic polymer such as on an electrically conductive substrate such as the metal surface of a model to be tested under cryogenic conditions and high Reynolds numbers. Next, a second dielectric layer of fused silica is formed on the first dielectric layer of thermoplastic polymer. A resistive metal film is deposited on selected areas of the multiple layer dielectric substrate to form one or more hot-film sensor elements to which aluminum electrical circuits deposited upon the multiple layered dielectric substrate are connected.


Official Gazette of the U.S. Patent and Trademark Office
A simple assembly for checking the perpendicularity of a hole relative to a datum surface is described. A "go" plug is inserted into the hole and serves as a mounting stand for a cylindrical disk which houses an indicator. The indicator is then rotated 360 deg while checking for any deflection of the indicator that would signal the hole is not perpendicular.

A method for determining the angle of impact of an object on a thin-walled structure which determines the angle of impact through analysis of the acoustic waves which result when an object impacts a structure is presented. Transducers are placed on and in the surface of the structure which sense the wave caused in the structure by impact. The waves are recorded and saved for analysis. For source motion normal to the surface, the antisymmetric mode has a large amplitude while that of the symmetric mode is very small. As the source angle increases with respect to the surface normal, the symmetric mode amplitude increases while the antisymmetric mode amplitude decreases. Thus, the angle of impact is determined by measuring the relative amplitudes of these two lowest order modes.

A method and apparatus for detecting the temperature of gray and non-gray bodies in the presence of interfering radiation are presented. A gray body has a constant emissivity less than 1 and a non-gray body has an emissivity which varies with wavelength. The emissivity and reflectivity of the surface is determined over a range of wavelengths. Spectra are also measured of the extraneous interference radiation source and the surface of the object to be measured in the presence of the extraneous interference radiation source. An auxiliary radiation source is used to determine the reflectivity of the surface and also the emissivity. The measured spectrum of the surfaces in the presence of the extraneous interference radiation source is set equal to the emissivity of the surface multiplied by a
Planck function containing a temperature term $T$ plus the surface reflectivity multiplied by the spectrum of the extraneous interference radiation source. The equation is then solved for $T$ to determine the temperature of the surface.

A handheld, programmable, digital camera is disclosed that supports a variety of sensors and has program control over the system components to provide versatility. The camera uses a high performance design which produces near film quality images from an electronic system. The optical system of the camera incorporates a conventional camera body that was slightly modified, thus permitting the use of conventional camera accessories, such as telephoto lenses, wide-angle lenses, auto-focusing circuitry, auto-exposure circuitry, flash units, and the like. An image sensor, such as a charge coupled device ('CCD') collects the photons that pass through the camera aperture when the shutter is opened, and produces an analog electrical signal indicative of the image. The analog image signal is read out of the CCD and is processed by preamplifier circuitry, a correlated double sampler, and a sample and hold circuit before it is converted to a digital signal. The analog-to-digital converter has an accuracy of eight bits to insure accuracy during the conversion. Two types of data ports are included for two different data transfer needs. One data port comprises a general purpose industrial standard port and the other a high speed/high performance application specific port. The system uses removable hard disks as its permanent storage media. The hard disk receives the digital image signal from the memory buffer and correlates the image signal with other sensed parameters, such as longitudinal or other information. When the storage capacity of the hard disk has been filled, the disk can be replaced with a new disk.
INSTRUMENTATION AND PHOTOGRAPHY

N93-17626* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ATMOSPHERIC PRESSURE FLOW REACTOR: GAS PHASE CHEMICAL KINETICS UNDER TROPOSPHERIC CONDITIONS WITHOUT WALL EFFECTS Patent

A flow reactor for simulating the interaction in the troposphere is set forth. A first reactant mixed with a carrier gas is delivered from a pump and flows through a duct having louvers therein. The louvers straighten out the flow, reduce turbulence, and provide laminar flow discharge from the duct. A second reactant delivered from a source through a pump is input into the flowing stream, the second reactant being diffused through a plurality of small diffusion tubes to avoid disturbing the laminar flow. The commingled first and second reactants in the carrier gas are then directed along an elongate duct where the walls are spaced away from the flow of reactants to avoid wall interference, disturbance, or turbulence arising from the walls. A probe connected with a measuring device can be inserted through various sampling ports in the second duct to complete measurements of the first and second reactants and the product of their reaction at selected XYZ locations relative to the flowing system.

N93-19387* National Aeronautics and Space Administration. Pasadena Office, CA.

LONG WAVELENGTH INFRARED DETECTOR Patent

Long wavelength infrared detection is achieved by a detector made with layers of quantum well material bounded on each side by barrier material to form paired quantum wells, each quantum well having a single energy level. The width and depth of the paired quantum wells, and the spacing therebetween, are selected to split the single energy level into two energy levels with a difference between levels sufficiently small for detection of infrared radiation of a desired wavelength.

N93-19328* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FLOW RATE LOGGING SEEPAGE METER Patent Application

An apparatus for remotely measuring and logging the flow rate of groundwater seepage into surface water bodies is described. As groundwater seeps into a cavity created by a bottomless housing, it displaces water through an inlet and into a waterproof sealed upper compartment, at which point, the water is collected by a collection bag, which is contained in a bag chamber. A magnet on the collection bag approaches a proximity switch as the collection bag fills, and eventually enables the proximity switch to activate a control circuit. The control circuit then rotates a three-way valve from the collection path to a discharge path, enables a data logger to record the time, and enables a pump, which discharges the water from the collection bag, through the three-way valve and pump, and into the sea. As the collection bag empties, the magnet leaves the proximity of the proximity switch, and the control circuit turns off the pump, resets the valve to provide a collection path, and restarts the collection cycle.

N93-19387* National Aeronautics and Space Administration. Pasadena Office, CA.

LONG WAVELENGTH INFRARED DETECTOR Patent

Long wavelength infrared detection is achieved by a detector made with layers of quantum well material bounded on each side by barrier material to form paired quantum wells, each quantum well having a single energy level. The width and depth of the paired quantum wells, and the spacing therebetween, are selected to split the single energy level into two energy levels with a difference between levels sufficiently small for detection of infrared radiation of a desired wavelength.

Official Gazette of the U.S. Patent and Trademark Office

N93-19328* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FLOW RATE LOGGING SEEPAGE METER Patent Application

An apparatus for remotely measuring and logging the flow rate of groundwater seepage into surface water bodies is described. As groundwater seeps into a cavity created by a bottomless housing, it displaces water through an inlet and into a waterproof sealed upper compartment, at which point, the water is collected by a collection bag, which is contained in a bag chamber. A magnet on the collection bag approaches a proximity switch as the collection bag fills, and eventually enables the proximity switch to activate a control circuit. The control circuit then rotates a three-way valve from the collection path to a discharge path, enables a data logger to record the time, and enables a pump, which discharges the water from the collection bag, through the three-way valve and pump, and into the sea. As the collection bag empties, the magnet leaves the proximity of the proximity switch, and the control circuit turns off the pump, resets the valve to provide a collection path, and restarts the collection cycle.
36 LASERS AND MASERS

Includes parametric amplifiers.

N93-13418* National Aeronautics and Space Administration. Pasadena Office, CA.
QUANTUM WELL, BEAM DEFLECTING SURFACE EMITTING LASERS Patent

This invention relates to surface emitting semiconductor lasers (SELs), with integrated 45 deg. beam deflectors. A SEL is formed on a wafer including vertical mirrors and 45 deg. beam deflectors formed in grooves by tilted ion beam etching. A SEL is a lattice matched, or unstrained, AIGaAs/GaAs GRINSCH SQW SEL. An alternate embodiment is shown, in which a SEL is lattice mismatched, strained or pseudomorphic, or InGaAs/AIGaAs GRINSCH SQW SEL which emits radiation at a wavelength with which its substrate is transparent. Both SELs exhibit high output power, low threshold current density, and relatively high efficiency, and each are compatible with conventional large scale integration technology. Such SELs may be fabricated in large numbers from single wafers. The novel features of this invention include the use of tilted ion beam etching to form a pair of grooves each including vertical mirrors and 45 deg. beam deflectors. The embodiment provides substantial circuit design flexibility because radiation may be coupled both up and/or down through the substrate.

Official Gazette of the U.S. Patent and Trademark Office

N93-14703* National Aeronautics and Space Administration. Pasadena Office, CA.
MULTIPERIOD-GRATING SURFACE-EMITTING LASERS Patent

Surface-emitting distributed feedback (DFB) lasers are disclosed with hybrid gratings. A first-order grating is provided at one or both ends of the active region of the laser for retroreflection of light back into the active region to stimulate or nonresonant grating is provided at the opposite end for coupling light out perpen-
36 LASERS AND MASERS

dicular to the surfaces of the laser or in some other selected direction. The gratings may be curved to focus light retroreflected into the active region and to focus light coupled out to a point. When so focused to a point, the DFB laser may be part of a monolithic read head for a laser recorded disk, or an optical coupler into an optical fiber.

Official Gazette of the U.S. Patent and Trademark Office

N93-18287* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DOPPLER SHIFT COMPENSATION SYSTEM FOR LASER TRANSMITTERS AND RECEIVERS Patent

This patent relates to a laser transmitting and receiving system that includes doppler compensation for large doppler shifts in frequency caused by relative motion between a collocated transceiver and a target or relative motion between separated transmitters and receivers. The system includes a tunable laser, a dithered laser optical frequency standard, and a computer for calculating the estimated Doppler shift at a given time using platform navigation and attitude control inputs as well as inputs relating to pointing data controlling the direction of transmission. The frequency standard and the computer output are employed to develop a Doppler compensation signal which may be used to shift the frequency of the laser transmitter or shift the bandpass of a laser receiver filter. The Doppler compensation is provided by a feedback loop which may include RF components, a timing trigger from the computer, or wavemeters.

Official Gazette of the U.S. Patent and Trademark Office

N93-19373** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
METHOD AND APPARATUS FOR DETECTION AND CONTROL OF PRELASING IN A Q-SWITCHED LASER Patent Application

The present invention detects prelasing in a Q-switch laser and terminates laser operation upon such detection. A detector senses the presence of light beyond a Q-switch and generates an appropriate electrical signal. A comparison stage circuit compares this detector signal with an established threshold value indicative of prelasing and generates a trigger signal if this detector signal exceeds this threshold value. A control stage circuit receives both this trigger value and a sampled Q-switch signal indicative of an opening of the Q-switch. The control stage circuit terminates operation of the
laser if the trigger signal from the comparison stage is received while
the sampled Q-switch signal is being received to avoid the effects of
prelasing. Appropriate delays and timing sequences are estab-
lished.

TERMINAL SLIDER CONTROL OF NONLINEAR ROBOTIC
SYSTEMS Patent Application
SUBARAMANIAN T. VENKATARAMAN, inventor (to NASA) (Jet
Propulsion Lab., California Inst. of Tech., Pasadena,) and SANDEEP
GULATI, inventor (to NASA) (Jet Propulsion Lab., California Inst. of
(Contract NAS7-918)
(NASA-CASE-NPO-18584-1-CU; NAS 1.71:NPO-18584-1-CU; US-
PATENT-APPL-SN-921192) Avail: CASI HC A03/MF A01

This invention provides robust nonlinear controllers for robotic
operations in unstructured environments based upon a new class of
sliding modes denoted terminal sliders that enforce closed loop
system convergence to equilibrium in finite time. Improved perfor-
mance results from the elimination of high frequency control switch-
ing previously employed for robustness to parametric uncertainties.
Improved performance also results from the dependence of terminal
slider stability upon the rate of change of uncertainties over the
sliding surface rather than the magnitude of the uncertainty itself for
robust control. Terminal sliding mode control also yields improved
convergence where convergence time is finite and is to be controlled.
This invention also applies terminal sliders to robot manipulator
control and benchmark performance with the traditional computed
torque control method and provides for design of control parameters.

METHOD AND APPARATUS FOR GRIPPING TEST
SPECIMENS Patent Application
REBECCA A. MACKAY, inventor (to NASA) and MICHAEL V.
NATHAL, Inventor (to NASA) 18 May 1992 12 p
(NASA-CASE-LEW-15345-1;NAS 1.71:LEW-15345-1;US-PATENT-
APPL-SN-884980) Avail: CASI HC A03/MF A01

A pair of solid-teeth wedges are employed in an improved
gripping system. The wedges fit inside a pair of plates having an
angled cavity to accommodate them. As stress is applied to the
specimen, the wedges are urged toward the specimen by the angled

N93-12203# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, OH.
AUTOMATIC SYSTEM FOR INSTALLATION AND
REPLACEMENT OF SPACE STATION COMPONENTS Patent
Application
ANDREW L. GORDAN, inventor (to NASA) and JAMES L. DOLCE,
inventor (to NASA) 28 May 1992 19 p
(NASA-CASE-LEW-14906-1; NAS 1.71:LEW-14906-1; US-PATENT-
APPL-SN-889572) Avail: CASI HC A03/MF A01

Service equipment for use in hostile environments is presented.
The equipment includes a detachable service unit secured to a
stationary service unit. The detachable service unit includes a hous-
ing with an exterior plate, a power control interface for connection to
an external power source, locating pins located in said exterior plate,
an electrical connector in the exterior plate electrically coupled to
said power control interface, and a pair of clamping receptacles
formed in the exterior plate and located on adjacent opposite edges
of the exterior plate. The stationary unit includes an electrical con-
ector for connection to the electrical connector of the detachable
service unit, a clamping apparatus for clamping and unclamping the
detachable service unit from the stationary unit, a base clamp
assembly for mounting the clamping apparatus onto the stationary
unit, and locating pin holes for receiving the locating pins and aligning
the detachable service unit onto the stationary unit. The detachable
service unit have mating scalloped faces which aid in alignment and
provide a mechanism for heat dissipation.

N93-12327# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, OH.

MECHANICAL ENGINEERING
includes auxiliary systems (nonpower); machine elements and pro-
ces; and mechanical equipment.
cavity to increase the gripping force. An alignment fixturing device is used to properly position the grips on the test specimen. This device not only axially aligns the grips but also locates them at the proper spacing.

NASA

N93-13417* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. PRELOADED LATCHING DEVICE Patent


A latching device is disclosed which is lever operated sequentially to actuate a set of collet fingers to provide a radial expansion and to actuate a force mechanism to provide a compressive gripping force for attaching first and second devices to one another. The latching device includes a body member having elongated collet fingers which, in a deactuated condition, is insertable through bores on the first and second devices so that gripping terminal portions on the collet fingers are proximate to the end of the bore of the first device while a spring assembly on the body member is located proximate to the outer surface of a second device. A lever is rotatable through 90 deg to move a latching rod to sequentially actuate and expand collet fingers and to actuate the spring assembly by compressing it. During the first 30 deg of movement of the lever, the collet fingers are actuated by the latching rod to provide a radial expansion and during the last 60 deg of movement of the lever, the spring assembly acts as a force mechanism and is actuated to develop a compressive latching force on the devices. The latching rod and lever are connected by a camming mechanism. The amount of spring force in the spring assembly can be adjusted; the body member can be permanently attached by a telescoping assembly to one of the devices; and the structure can be used as a pulling device for removing annular bearings or the like from blind bores.

Official Gazette of the U.S. Patent and Trademark Office

N93-13423* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. FASTENING APPARATUS HAVING SHAPE MEMORY ALLOY ACTUATOR Patent

DARIN N. MCKINNIS, inventor (to NASA) 3 Nov. 1992 9 p Filed 13 May 1992 Supersedes N92-29762 (30 - 20, p 3479)


A releasable fastening apparatus is presented. The device includes a connecting member and a housing. The housing supports a gripping mechanism that is adapted to engage the connecting member. A triggering member is movable within the housing between a first position in which it constrains the gripping mechanism in locked engagement with the connecting member, and a second position in which the gripping mechanism is disengaged from the connecting member. A shaped memory alloy actuator is employed for translating the triggering member from its first to its second position. The actuator is designed to expand longitudinally when transitioned from a martensitic to an austenitic state.

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A thruster nozzle sealing system and apparatus is provided for protection of spacecraft thruster motors. The system includes a sealing plug, a sealing plug insertion tool, an outer cover, an outer cover attachment, and a ferry flight attachment. The sealing plug prevents moisture from entering the thruster engine so as to prevent valve failure. The attachments are interchangeably connectable with the sealing plug. The ferry flight attachment is used during air transportation of the spacecraft, and the outer cover attachment is used during storage and service of the spacecraft. The outer cover provides protection to the thruster nozzle from mechanical damage.

A retractable tool bit assembly utilized in connection with a robotic gripper type end-effector is presented. The apparatus includes one or more spring loaded nestable or telescoping tubular sections together with a catch mechanism for capturing and holding the tool, such as an allen key, in its retracted position. The innermost tubular section includes a threshold cap and engages and holds the tool. The catch mechanism consists of a slider type mechanism located adjacent a relatively larger outer base section and includes means for engaging a conically or mushroom shaped rear end portion of the tool when the telescoping sections are moved to a retracted or parked position. The catch mechanism is released upon actuation of a rotary tool drive motor coupled to a circular mount and which holds the base section. When released the all the telescoping sections including the tool extends fully outward to a use position.

A mechanical coupling system is described wherein a spline screw system is used to connect two bodies, a work attachment mechanism and a work attachment fixture. A kinematic clamp first guides and mates the attachment mechanism to the attachment fixture. The kinematic clamp includes three round roller members equidistantly located around the periphery of the bodies and three correspondingly located V-shaped grooves located on the periphery of the other body. A motor driven spline screw in the attachment mechanism then engages a spline bolt head in the attachment fixture and includes a threaded shank upon which is mounted a translatable nut which is adapted to translate up and down the shank but not rotate. The nut carries one or more electrical connectors which travel upwardly during a connecting sequence and cams open a set of dust covers which operate to engage an opposing set of dust covers adjacent complementary type electrical connectors on the attachment mechanism. A mechanical and electrical interconnection process between the bodies occurs sequentially.
A portable hand-grip device for use during extravehicular activity is described. The device has a base member overlaid by a flexible pad having its opposite end releasably secured to the base. The pad includes an adhesive-covered surface which may be attached to a flat surface. A plurality of closely-spaced elongated rigid members are arranged side-by-side across the back of the flexible sheet to reinforce the flexible pad. The ends of these reinforcing members project beyond the opposite sides of the base and flexible pad. A selectively-operable mechanism on the base member releasably captures the outer end of the reinforcing members and secures them when the pad member is attached to a flat surface and provides a load path between a handle on the base and the flexible pad. The selectively-operable mechanism is further arranged to selectively release the reinforcing members so that the device may be progressively peeled away from a wall surface.

A control valve includes a body defining a central cavity arranged between a fluid inlet and outwardly-diverging first and second fluid outlets respectively disposed in a common transverse plane. A valve member is arranged in the cavity for rotation between first and second operating positions where a transverse fluid passage through the valve member alternatively communicates the fluid inlet with one or the other of the fluid outlets. To minimize fluid turbulence when the valve member is rotated to an alternate operating position, the fluid passage has a convergent entrance for maintaining the passage in permanent communication with the fluid inlet as well as an oblong exit opening with spaced side walls for enabling the exit opening to temporarily span the first and second fluid outlets as the valve member is turned between its respective operating positions.
SADDLE CLAMP ASSEMBLY Patent Application
CHARLES R. BELROSE, inventor (to NASA) 17 Nov. 1992 14 p

A saddle clamp assembly is presented. The assembly is comprised of a hollow cylindrical body centered about a longitudinal axis and being diametrically split into semicircular top and bottom sections. Each section has a pair of connection flanges, at opposite ends, that project radially outward. A pair of bolts are retained on the top section flanges and are threadable into nuts retained on the bottom section flanges. A base member is anchored to a central underside portion of the bottom clamp body section and has a pair of connection tabs positioned beneath the bottom clamp body section connection flanges on opposite sides of the clamp axis. A pair of bolts are retained on the base member connection tabs and are threadable into a pair of nuts retainable on a support structure. The connection tab and connection flanges on each side of the clamp body are axially offset in a manner permitting downward installation/removable tool access to the lower bolts past the connection flanges. An elongated retention tether is used to connect the top clamp body section to the balance of the clamp assembly. This prevents loss of the top clamp body section when it is removed from the bottom clamp body section.

SLIP JOINT CONNECTOR Patent Application
FRANK P. THOMAS, inventor (to NASA) 28 Aug. 1992 12 p

A slip joint connector for joining first and second structural elements together is presented. The connector has a first body member attachable to the first structural element and a second body member attachable to the second structural element. The first body member has a male protuberance including a conical portion and the second body member has a conical receptacle for cooperatively receiving the conical portion of the protuberance. The protuberance includes a bridging portion. The conical male portion internally carries a nut while the second body member may receive a bolt through the receptacle to be threadedly received by the nut to secure the first and second body members tightly together.

RADIAL SPLINE ASSEMBLY FOR ANTIFRICTION BEARINGS Patent Application
JERRY H. MOORE, inventor (to NASA) 7 Oct. 1992 14 p

An outer race carrier is constructed for receiving an outer race of an antifriction bearing assembly. The carrier in turn is slidably fitted in an opening of a support wall to accommodate slight axial movements of a shaft. A plurality of longitudinal splines on the carrier are disposed to be fitted into matching slots in the opening. A deadband gap is provided between sides of the splines and slots, with a radial gap at ends of the splines and slots and a gap between the splines and slots sized larger than the deadband gap. With this construction, operational distortions (slope) of the support wall are accommodated by the larger radial gaps while the deadband gaps maintain a relatively high springrate of the housing. Additionally, side loads applied to the shaft are distributed between sides of the splines and slots, distributing such loads over a larger surface area than a race carrier of the prior art.
A synthetic apatite containing agronutrients and a method for making the apatite are disclosed. The apatite comprises crystalline calcium phosphate having agronutrients dispersed in the crystalline structure. The agronutrients can comprise potassium, magnesium, sulfur, iron, manganese, molybdenum, chlorine, boron, copper and zinc in amounts suited for plant growth. The apatite can optionally comprise a carbonate and/or silicon solubility control agent. The agronutrients are released slowly as the apatite dissolves.

In a robot having a gripper including a pair of fingers and a drive motor for driving the fingers toward and away from one another while the fingers remain parallel to each other, the fingers consist of finger pads, which interface with a handle on an object to be grasped, and a shank, which attaches the fingers to the robot gripper. The double-V finger has two orthogonal V-grooves forming in the center of the finger pads and recessed cruciform. The double-V finger is used with a handle on the object to be grasped which is the negative of the finger pads. The handle face consists of V-shaped pads capped with a rectangular cruciform. As the gripper is brought into place near the handle, the finger pads are lined up facing the handle pads. When the finger pad and the handle pad are in proper alignment, the rectangular ridges on the handle fall inside the rectangular grooves on the finger, and the grip is complete.

A retractable tool bit assembly for a tool such as an alien key is presented. The assembly includes one or more spring loaded nestable or telescoping tubular sections together with a catch mechanism for capturing and holding the tool in its retracted position. The catch mechanism consists of a latch mechanism located in a base section and which engages a conically shaped tool head located at the inner end of the tool. The tool head adjoins an eccentric oval type neck portion which extends to a rear lip of the tool head. The latch mechanism releases when the ovular neck portion rotates about the catch members upon actuation of a rotary tool drive motor. When released, all the telescoping sections and the tool extends fully.
outward to a use position. Ovular neck portion rotates about the catch members upon actuation of a rotary tool drive motor. When released, all the telescoping sections and the tool extends fully outward to a use position.

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N93-18288* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, MD.
SPLIT RAIL GRIPPER ASSEMBLY AND TOOL DRIVER
THEREFOR Patent
GEORGE M. VOELLMER, inventor (to NASA) 9 Feb. 1993 10 p
Filed 2 Sep. 1992 Continuation-in-part of US-Patent-Appl-SN-
656924, filed 15 Feb. 1991
(NASA-CASE-GSC-13370-2; US-PATENT-5,184,861; US-PATENT-
APPL-SN-938577; US-PATENT-APPL-SN-656924; US-PATENT-

This patent relates to a split rail gripper for a robotic apparatus including a pair of rails which are driven in mutually opposite directions by a rack and pinion gear mechanism. Each rail includes a set of rack gear teeth which engage respective pinion gears and where the top rail engaging one of the pinion gears is driven by a harmonic gear reduction drive and motor unit coupled to a drive screw. The other pinion gear is driven by the top pinion gear engaging a set of rack gear teeth included in the bottom rail. As the top rail is driven in or out, the upper pinion gear is rotated, causing the other pinion gear, in turn, to rotate in the opposite direction. This causes the bottom rail to move in an opposite linear direction relative to the top rail. An outwardly extending gripper finger assembly is attached to respective ends of the rails, with each gripper finger including an arrangement of vertically and horizontally mounted roller members which operate to automatically center and engage an H-plate type interface secured to the object being grasped. The gripper assembly also includes a base plate attached to an interface plate of a robotic tool changer mechanism. A retractable rotary tool driver and tool is also centrally mounted on the base plate.

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N93-19027# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE, BELLOWS HYBRID SEAL Patent
Application
B. M. STEINETZ, inventor (to NASA) and P. J. SIROCKY, inventor
(to NASA) (Sverdrup Technology, Inc., Brook Park, OH) 22 Jan.
1993 15 p
(NASA-CASE-LEW-15570-1; NAS 1.71:LEW-15570-1; US-PATENT-
APPL-SN-007874) Avail: CASI HC A03/MF A01

A high-temperature hybrid seal is constructed of multiple elements to meet the many demands placed on the seal. The primary elements are: a central high-temperature bellows, a braided ceramic sheath covering the bellows, an outer abrasion resistant sheath covering the ceramic sheath, and a structurally-sound seal-end termination.

NASA

N93-19049*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, AL.
VALVE LOCK Patent Application
RICHARD K. BURLEY, inventor (to NASA) (Rockwell International
Corp., Huntsville, AL) and KAMAL S. GUIRGUIS, inventor (to
NASA) (Rockwell International Corp., Huntsville, AL) 17 Nov. 1992
11 p
(NASA-CASE-MFS-29764-1; NAS 1.71:MFS-29764-1; US-PATENT-
APPL-SN-977469) Avail: CASI HC A03/MF A01

A valve security lock is provided which secures a double union ball valve. The lock is formed from a band inserted through slits in a tube, with that combination being positioned over the valve stem to be secured, and the ends of the band wrapped around the circumference of the double union ball valve. The apparatus is secured around the double union ball valve by insertion of the shank of a lock of known kind through holes in the ends of the band. In a fluid control system, the valve security lock provides a highly visible means to prevent accidental turn-ons or turn-offs during system maintenance, but which can be easily disengaged by persons having the key or combination to the shank type lock.

NASA

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A hydraulically powered gas compressor receives low pressure gas and outputs a high pressure gas. The housing of the compressor defines a cylinder with a center chamber having a cross-sectional area less than the cross-sectional area of a left end chamber and a right end chamber, and a spool-type piston assembly is movable within the cylinder and includes a left end closure, a right end closure, and a center body that are in sealing engagement with the respective cylinder walls as the piston reciprocates. First and second annual compression chambers are provided between the piston enclosures and center housing portion of the compressor, thereby minimizing the spacing between the core gas and a cooled surface of the compressor. Restricted flow passageways are provided in the piston closure members and a path is provided in the central body of the piston assembly, such that hydraulic fluid flows through the piston assembly to cool the piston assembly during its operation. The compressor of the present invention may be easily adapted for a particular application, and is capable of generating high gas pressures while maintaining both the compressed gas and the compressor components within acceptable temperature limits.

An apparatus, system, and method for non-destructible evaluation (NDE) of a material use thermography to rapidly detect and/or generally locate a feature such as, for example, damage or a defect in the material. The apparatus, system, and method also use ultrasound to specifically locate the feature in the material for quantification and/or evaluation either by an operator or by an external device suited for such purpose. Accordingly, the apparatus, system, and method are particularly useful for NDE in applications such as the analysis of the structure of an aircraft, for example, in which the scale of the material to be analyzed is large, thus requiring the rapid NDE afforded by thermography, and in which quantification and/or evaluation of a feature must be performed with precision, thus requiring the relatively high-resolution NDE afforded by ultrasound.
METEOROLOGY AND CLIMATOLOGY

A device and method are provided which non-destructively detect crack length and crack geometry in thin metallic plates. A non-contacting vibration apparatus produces resonant vibrations without introducing extraneous noise. Resulting resonant vibration shifts in cracked plates are correlated to known crack length in plates with similar resonant vibration shifts. In addition, acoustic emissions of cracks at resonance frequencies are correlated to acoustic emissions from known crack geometries.

N93-19329* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

METHOD AND APPARATUS FOR MINIMIZING MULTIPLE DEGREE OF FREEDOM VIBRATION TRANSMISSION BETWEEN TWO REGIONS OF A STRUCTURE Patent


Arrays of actuators are affixed to structural elements to impede the transmission of vibrational energy. A single pair is used to provide control of bending and extensional waves and two pairs are used to control torsional motion. The arrays are applied to a wide variety of structural elements such as a beam structure that is part of a larger framework that may or may not support a rigid or non-rigid skin. Electrical excitation is applied to the actuators that generate forces on the structure. These electrical inputs may be adjusted in their amplitude and phase by a controller in communication with appropriate vibrational wave sensors to impede the flow of vibrational power in all of the above mentioned wave forms beyond the actuator location. Additional sensor elements can be used to monitor the performance and adjust the electrical inputs to maximize the attenuation of vibrational energy.

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METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N93-10108* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

METHOD AND APPARATUS FOR DETERMINING RETURN STROKE POLARITY OF DISTANT LIGHTNING Patent


A method is described for determining the return stroke polarity of distant lightning for distances beyond 600 km by detecting the electric field associated with a return stroke of distant lightning, and processing the electric field signal to determine the polarity of the slow tail portion of the waveform. The polarity of the return stroke of distant lightning is determined based upon the polarity of the slow tail portion of the waveform.

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METHOD FOR CULTURING MAMMALIAN CELLS IN A PERFUSED BIOREACTOR Patent


A bio-reactor system wherein a tubular housing contains an internal circularly disposed set of blade members and a central tubular filter all mounted for rotation about a common horizontal axis and each having independent rotational support and rotational drive mechanisms. The housing, blade members and filter preferably are driven at a constant slow speed for placing a fluid culture medium with discrete microbeads and cell cultures in a discrete spatial suspension in the housing. Replacement fluid medium is symmetrically input and fluid medium is symmetrically output from the housing where the input and the output are part of a loop providing a constant or intermittent flow of fluid medium in a closed loop.

METHOD FOR CULTURING MAMMALIAN CELLS IN A HORIZONTALLY ROTATED BIOREACTOR Patent


A bio-reactor system where cell growth microcarrier beads are suspended in a zero head space fluid medium by rotation about a horizontal axis and where the fluid is continuously oxygenated from a tubular membrane which rotates on a shaft together with rotation of the culture vessel. The oxygen is continuously throughput through the membrane and disbursed into the fluid medium along the length of the membrane.

METHOD FOR CONDUCTING AN IN VITRO CELL ASSAY USING A TETRAZOLIUM INDICATOR Patent


A method for conducting an in vitro cell assay using a tetrazolium indicator is disclosed. The indicator includes a nonionic detergent which solubilizes a tetrazolium reduction product in vitro and has low toxicity for the cells. The incubation of test cells in the presence of zolium bromide and octoxynol (TRITON X-100) permits kinetics of the cell metabolism to be determined.
is connected in parallel with the iodinated resin bed and is activated periodically (e.g., by timer, by measured flow of water, or by iodine residual level) to recharge the bed. Novelty resides in the capability of inexpensively and repeatedly regenerating the ion-exchange bed in sites.

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An annular culture vessel for growing mammalian cells is constructed in a one piece integral and annular configuration with an open end which is closed by an endcap. The culture vessel is rotatable about a horizontal axis by use of conventional roller systems commonly used in culture laboratories. The end wall of the endcap has tapered access ports to frictionally and sealingly receive the ends of hypodermic syringes. The syringes permit the introduction of fresh nutrient and withdrawal of spent nutrients. The walls are made of conventional polymeric cell culture material and are subjected to neutron bombardment to form minute gas permeable perforations in the walls.

A synthetic soil/fertilizer for horticultural application having all the agronutrients essential for plant growth is disclosed. The soil comprises a synthetic apatite fertilizer having sulfur, magnesium, and micronutrients dispersed in a calcium phosphate matrix, a zeolite cation exchange medium saturated with a charge of potassium and nitrogen cations, and an optional pH buffer. Moisture dissolves the apatite and mobilizes the nutrient elements from the apatite matrix and the zeolite charge sites.

A compliant walker is provided for humans having limited use of their legs and lower back. It includes an upright wheel frame which at least partially surrounds an upright user wearing a partial body harness. It is attached to the frame by means of cable compliant apparatus consisting of sets of cable segments and angle bracket members connected between opposite side members of the frame and adjacent side portions of the harness. Novelty is believed to exist in the combination of a wheeled frame including a side support
structure, a body harness, and compliance means connecting the body harness to the side support structure for flexibility holding and supporting a person in a substantially upright position when the user sags in the frame when taking weight off the lower extremities.

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A passive zero or microgravity leg restraint is described which includes a central support post with a top and a bottom. Extending from the central support post are a calf pad tab, to which calf pad is attached, and a foot pad tab, to which foot tab is attached. Also extending from central support post are knee pads. When the restraint is in use the user's legs are forced between pads by a user imposed scissors action of the legs. The user's body is then supported in a zero or microgravity neutral body posture by the leg restraint. The calf pad has semi-ridig elastic padding material covering structural stiffener. The foot pad has padding material and a structural stiffener. Knee pads have structural tube stiffener at their core.

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A bright light therapy delivery system is disclosed. The system enhances the efficient delivery of bright light therapy by directing the light to the user's eyes while permitting the user to engage in other sedentary activities, such as reading. A shroud is disclosed which has reflective non-specular interior surfaces and which enclosed a bright light source of known kind. The shroud can be configured for delivery of bright light therapy in a direct, indirect, or direct/indirect mode. In the direct mode, the bright light source is located at the back of the shroud and faces the user; in the indirect mode, the bright light source is located within the shroud and faces away from the user; in the direct/indirect mode, the bright light source is located within the shroud, and has two luminous appertures, one facing the user and the other facing opposite the user.

NASA

A bar-holding prosthetic limb is described which includes a yoke adapted to be positioned about the user's upper arm and providing a handle adapted to be grasped by the user's hand. A bar is connected to the yoke and is adapted to be grasped by the user's hand. The bar-holding prosthesis includes a handle and a gripping surface, and the handle is adapted to be grasped by the user's hand. The gripping surface is adapted to provide a means for gripping the handle. The handle is adapted to provide a means for gripping the bar-holding prosthesis.
A prosthetic device for below-the-elbow amputees is disclosed. The device has a removable effector, which is attached to the end of an arm cuff. The effector is comprised of a pair of C-shaped members that are oriented so as to face each other. Working in concert, the C-shaped members are able to hold a bar such as a chainsaw handle. A flat spring is fitted around the C-shaped members to hold them together.

A wheel is provided herein for vehicles using spoked wheels. Small obstacles, steps, and curbs present serious impediments to wheelchair and bicycle travelers. Yet until recently wheels for these vehicles have remained unchanged. These rigid type vehicles have the disadvantage of transmitting to their users shocks and vibrations generated by traversing over obstacles or rough terrain, creating an uncomfortable ride. The wheel herein responds to loads or shocks while overcoming the difficulties of prior art wheels. The wheel herein responds to loads or shocks while overcoming the difficulties of prior art wheels. The wheel herein responds to loads or shocks while overcoming the difficulties of prior art wheels. The wheel here responds to loads or shocks while overcoming the difficulties of prior art wheels.

A portable seat lift that can help individuals either (1) lower themselves to a sitting position or (2) raise themselves to a standing position is presented. The portable seat lift consists of a seat mounted on a base with two levers, which are powered by a drive unit.
The invention is a protective helmet assembly with improved safety and impact resistance, high resistance to ignition and combustion, and reduced offgassing. The assembly comprises a hard rigid ballistic outer shell with one or more impact absorbing pads fitted to the interior surface. The pads are made of open cell flexible polyimide foam material, each of which is attached to the inner surface of the ballistic outer shell by cooperative VELCRO fastener strips of hook-and-loop material affixed respectively to the rigid outer shell and the impact absorbing pads. The helmet assembly with shell and pads is sized to fit relatively close over a wearer's head.

A high speed read MRAM memory element is configured from a sandwich of magnetizable, ferromagnetic film surrounding a magneto-resistive film which may be ferromagnetic or not. One outer ferromagnetic film has a higher coercive force than the other and therefore remains magnetized in one sense while the other may be switched in sense by a switching magnetic field. The magneto-resistive film is therefore sensitive to the amplitude of the resultant field between the outer ferromagnetic films and may be constructed of a high resistivity, high magneto-resistive material capable of higher sensing currents. This permits higher read voltages and therefore faster read operations. Alternate embodiments with perpendicular anisotropy, and in-plane anisotropy are shown, including an embodiment which uses high permeability guides to direct the closing flux path through the magneto-resistive material. High density, high speed, radiation hard, memory matrices may be constructed from these memory elements.
N93-14682* National Aeronautics and Space Administration, Pasadena Office, CA.
MODIFIED FAST FREQUENCY ACQUISITION VIA ADAPTIVE LEAST SQUARES ALGORITHM Patent

A method and the associated apparatus for estimating the amplitude, frequency, and phase of a signal of interest are presented. The method comprises the following steps: (1) inputting the signal of interest; (2) generating a reference signal with adjustable amplitude, frequency and phase at an output thereof; (3) mixing the signal of interest with the reference signal and a signal 90 deg out of phase with the reference signal to provide a pair of quadrature sample signals comprising respectively a difference between the signal of interest and the reference signal and a difference between the signal of interest and the signal 90 deg out of phase with the reference signal; (4) using the pair of quadrature sample signals to compute estimates of the amplitude, frequency, and phase of an error signal comprising the difference between the signal of interest and the reference signal and a difference between the signal of interest and the signal 90 deg out of phase with the reference signal; (5) adjusting the amplitude, frequency, and phase of the reference signal from the numerically controlled oscillator in a manner which drives the error signal towards zero; and (6) outputting the estimates of the amplitude, frequency, and phase of the error signal in combination with the reference signal to produce a best estimate of the amplitude, frequency, and phase of the signal of interest. The preferred method includes the step of providing the error signal as a real time confidence measure as to the accuracy of the estimates wherein the closer the error signal is to zero, the higher the probability that the estimates are accurate. A matrix in the estimation algorithm provides an estimate of the variance of the estimation error.

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N93-18855* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.
SYSTEM FOR SIMULTANEOUSLY LOADING PROGRAM TO MASTER COMPUTER MEMORY DEVICES AND CORRESPONDING SLAVE COMPUTER MEMORY DEVICES Patent

A bus programmable slave module card for use in a computer control system is disclosed which comprises a master computer and one or more slave computer modules interfacing by means of a bus. Each slave module includes its own microprocessor, memory, and control program for acting as a single-loop controller. The slave card includes a plurality of memory means (S1, S2...) corresponding to a like plurality of memory devices (C1, C2...) in the master computer, for each slave memory means its own communication lines connectable through the bus with memory communication lines of an associated memory device in the master computer, and a one-way, electronic door which is switchable to either a closed condition or an open condition. With the door closed, communication lines between master computer memory (C1, C2...) and slave memory (S1, S2...) are blocked. In the one-way open condition invention, the memory communication lines or each slave memory means (S1, S2...) connect with the memory communication lines of its associated

N93-18282* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.
GENERAL METHOD OF PATTERN CLASSIFICATION USING THE TWO-DOMAIN THEORY Patent

Human beings judge patterns (such as images) by complex mental processes, some of which may not be known, while computing machines extract features. By representing the human judgments with simple measurements and reducing them and the machine extracted features to a common metric space and fitting them by regression, the judgments of human experts rendered on a sample of patterns may be imposed on a pattern population to provide automatic classification.

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memory device (C1, C2...) in the master computer, and the memory
devices (C1, C2...) of the master computer and slave card are
electrically parallel such that information seen by the master's
memory is also seen by the slave's memory. The slave card is also
connectable to a switch for electronically removing the slave micro-
processor from the system. With the master computer and the slave
card in programming mode relationship, and the slave microproces-
sor electronically removed from the system, loading a program in the
memory devices (C1, C2...) of the master accomplishes a parallel
loading into the memory devices (S1, S2...) of the slave.

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CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics
and expert systems.

N93-11174* National Aeronautics and Space Administration.
Pasadena Office, CA.

THE ADAPTIVE NEURON MODEL: AN ARCHITECTURE FOR
THE RAPID LEARNING OF NONLINEAR TOPOLOGICAL
TRANSFORMATIONS Patent Application

RAOU L TAWEL, inventor (to NASA) (Jet Propulsion Lab., California
Inst. of Tech., Pasadena) 28 Aug. 1992 34 p
(Contract NAS7-918)
(NASA-CASE-NPO-18579-1-CU; NAS 1.71:NPO-18579-1-CU; US-
PATENT-APPL-SN-937335) Avail: CASI HC A03/MF A01

A method for the rapid learning of nonlinear mappings and
topological transformations using a dynamically reconfigurable arti-
ficial neural network is presented. This fully-recurrent Adaptive Neu-
ron Model (ANM) network was applied to the highly degenerate
inverse kinematics problem in robotics, and its performance evaluation
is bench-marked. Once trained, the resulting neuromorphic
architecture was implemented in custom analog neural network
hardware and the parameters capturing the functional transformation
downloaded onto the system. This neuroprocessor, capable of 10(exp
9) ops/sec, was interfaced directly to a three degree of freedom
Heathkit robotic manipulator. Calculation of the hardware feed-
forward pass for this mapping was benchmarked at approximately 10
microsec.

N93-14701* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, MD.

DRIVEN SHIELDING CAPACITIVE PROXIMITY SENSOR Patent

JOHN M. V RANDISH, inventor (to NASA) and ROBERT L.
MCCONNELL, inventor (to NASA) 24 Nov. 1992 5 p
(Contract NAS7-918)
(NASA-CASE-GSC-13377-1; US-PATENT-5,166,679; US-PATENT-
APPL-SN-710845; US-PATENT-CLASS-340-870,37; US-PATENT-
CLASS-324-687; US-PATENT-CLASS-340-552; INT-PATENT-
CLASS-G08C-19/10; INT-PATENT-CLASS-G08B-13/26) Avail: US
Patent and Trademark Office
A capacitive proximity sensing element, backed by a reflector driven at the same voltage as and in phase with the sensor, is used to reflect the field lines away from a grounded robot arm towards an intruding object, thus dramatically increasing the sensor's range and sensitivity.
achieved in under 500 iterations compared to 20000 previously required. The trajectories computed using our new method are much closer to the target trajectories than was reported in previous studies.

NASA

NUMERICAL CONTROL FABRICATION TECHNIQUE FOR DYNAMIC COMPOSITE MODELS Patent Application

In a method of fabricating an article such as a dynamic model or a part thereof, a computer-driven machining means, such as a numerically controlled machine, is used to cut a core material such as a rigid foam into a desired shape and to a size specification that is slightly smaller than the final size desired to the article. Alternating layers of a polymer resin such as polyester and a reinforcing fabric such as fiberglass cloth are then applied to the surface of the core material, causing a build-up of layers of polymer resin and reinforcing fabric to a point at which the item being fabricated is oversized from that desired. Finally, a computer-driven machining means is used to cut the article being fabricated to exact size and shape specifications, leaving a desired thickness of reinforcing material.

NASA

ACOUSTICS

Includes sound generation, transmission, and attenuation.

N93-13421* National Aeronautics and Space Administration. Pasadena Office, CA.
ACOUSTIC DEVICE AND METHOD FOR MEASURING GAS DENSITIES Patent

Density measurements can be made in a gas contained in a flow through enclosure by measuring the sound pressure level at a receiver or microphone located near a dipole sound source which is driven at constant velocity amplitude at low frequencies. Analytical results, which are provided in terms of geometrical parameters, wave numbers, and sound source type for systems of this invention, agree well with published data. The relatively simple designs feature a transmitter transducer at the closed end of a small tube and a receiver transducer on the circumference of the small tube located a small distance away from the transmitter. The transmitter should be a dipole operated at low frequency with the kl value preferable less that about 0.3.

Official Gazette of the U.S. Patent and Trademark Office

N93-17051* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CONSECUTIVE PLATE ACOUSTIC SUPPRESSOR APPARATUS AND METHODS Patent Application

An apparatus and method for suppressing acoustic noise utilizes consecutive plates, closely spaced to each other so as to exploit dissipation associated with sound propagation in narrow channels to optimize the acoustic resistance at a liner surface. The closely
spaced plates can be utilized as high temperature structural materials for jet engines by constructing the plates from composite materials. Geometries of the plates, such as plate depth, shape, thickness, inter-plate spacing, arrangement, etc., can be selected to achieve bulk material-like behavior.

**OPTICS**

Includes light phenomena; and optical devices.


A projected fringe interferometer for measuring the topography of an object is presented. The interferometer periodically steps the phase angle between a pair of light beams emanating from a common source. The steps are π/2 radians (90 deg) apart, and at each step a video image of the fringes is recorded and stored. Photodetectors measure either the phase and theta of the beams or 2(θ). Either of the measures can be used to control one of the light beams so that the 90 deg θ is accurately maintained. A camera, a computer, a phase controller, and a phase modulator established closed-loop control of θ. Measuring the phase map of a flat surface establishes a calibration reference.

Official Gazette of the U.S. Patent and Trademark Office
A spectral imaging system having an integrated filter and photodetector array is disclosed. The filter has narrow transmission bands which vary in frequency along the photodetector array. The frequency variation of the transmission bands is matched to, and aligned with, the frequency variation of a received spectral image. The filter is deposited directly on the photodetector array by a low temperature deposition process. By depositing the filter directly on the photodetector array, permanent alignment is achieved for all temperatures, spectral crosstalk is substantially eliminated, and a high signal to noise ratio is achieved.

Official Gazette of the U.S. Patent and Trademark Office

The performance of five symbol lock detectors are compared. They are the square-law detector with overlapping (SQOD) and non-overlapping (SQNOD) integrators, the absolute value detectors with overlapping and non-overlapping (AVNOD) integrators and the signal power estimator detector (SPED). The analysis considers various scenarios when the observation interval is much larger or equal to the symbol synchronizer loop bandwidth, which has not been considered in previous analyses. Also, the case of threshold setting in the absence of signal is considered. It is shown that the SQOD outperforms all others when the threshold is set in the presence of signal, independent of the relationship between loop bandwidth and observation period. On the other hand, the SPED outperforms all others when the threshold is set in the presence of noise only.

Official Gazette of the U.S. Patent and Trademark Office

A relatively small and low-cost system is provided for projecting a large and bright television image onto a screen. A miniature liquid crystal array is driven by video circuitry to produce a pattern of transparencies in the array corresponding to a television image. Light is directed against the rear surface of the array to illuminate it, while a projection lens lies in front of the array to project the image of the array onto a large screen. Grid lines in the liquid crystal array are eliminated by a spatial filter which comprises a negative of the Fourier transform of the grid.

Official Gazette of the U.S. Patent and Trademark Office

An x-ray monochromator is described, wherein a housing supports a plurality of mirrors forming a plurality of opposed mirror faces in parallel with each other and having thereon multilayer coatings, with each of said pairs of mirror faces being provided with identical coatings which are different from the coatings on the other pairs of mirror faces such that each pair of mirror faces has a peak x-ray reflection at a different wavelength regime. The housing is moveable to bring into a polychromatic x-ray beam that pair of mirror faces
having the best x-ray reflection for the desired wavelength, with the mirrors being pivotable to move the mirror faces to that angle of incidence at which the peak reflectivity of the desired wavelength x-rays occurs.

Official Gazette of the U.S. Patent and Trademark Office

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<table>
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<th>Patent Application</th>
<th>Description</th>
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<tbody>
<tr>
<td>RICHARD F. HELLBAUM, inventor (to NASA), RICHARD O. CLAUS, inventor (to NASA), KENT A. MURPHY, inventor (to NASA), and MICHAEL F. GUNTHER, inventor (to NASA)</td>
<td>An interferometer includes a first optical fiber coupled to a second optical fiber by fusing. At a fused portion, the first and second optical fibers are cut to expose respective cores. The cut or fused end of the first and second optical fibers is arranged to oppose a diaphragm or surface against which a physical phenomenon such as pressure or stress, is applied. In a first embodiment, a source light which is generally single-mode monochromatic, coherent light, is input to the first optical fiber and by evanescence, effectively crosses to the second optical fiber at the fused portion. Source light from the second optical fiber is reflected by the diaphragm or surface, and received at the second optical fiber to generate an output light which has an intensity which depends upon interference of reference light based on the source light, and the reflected light reflected from the diaphragm or surface. The intensity of the output light represents a positional relationship or displacement between the interferometer and the diaphragm or surface.</td>
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<tr>
<td>DANIEL B. DINER, inventor (to NASA)</td>
<td>Real-time video presentations are provided in the field of operator-supervised automation and teleoperation, particularly in control stations having movable cameras for optimal viewing of a region of interest in robotics and teleoperations for performing different types of tasks. Movable monitors to match the corresponding camera orientations (pan, tilt, and roll) are provided in order to match the coordinate systems of all the monitors to the operator internal coordinate system. Automated control of the arrangement of cameras and monitors, and of the configuration of system parameters, is provided for optimal viewing and performance of each type of task for each operator since operators have different individual characteristics. The optimal viewing arrangement and system parameter configuration is determined and stored for each operator in performing each of many types of tasks in order to aid the automation of setting up optimal arrangements and configurations for successive tasks in real time. Factors in determining what is optimal include the operator's ability to use hand-controllers for each type of task. Robot joint locations, forces and torques are used, as well as the operator's identity, to identify the current type of task being performed in order to call up a stored optimal viewing arrangement and system parameter configuration.</td>
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NEAR REAL-TIME STEREO VISION SYSTEM Patent
The apparatus for a near real-time stereo vision system for use with a robotic vehicle is described. The system is comprised of two cameras mounted on three-axis rotation platforms, image-processing boards, a CPU, and specialized stereo vision algorithms. Bandpass-filtered image pyramids are computed, stereo matching is performed by least-squares correlation, and confidence ranges are estimated by means of Bayes' theorem. In particular, Laplacian image pyramids are built and disparity maps are produced from the 60 x 64 level of the pyramids at rates of up to 2 seconds per image pair. The first autonomous cross-country robotic traverses (of up to 100 meters) have been achieved using the stereo vision system of the present invention with all computing done onboard the vehicle. The overall approach disclosed herein provides a unifying paradigm for practical domain-independent stereo ranging.

OPTICAL FIBER STRAIN SENSOR WITH IMPROVED LINEARITY Patent Application
A strain sensor is constructed from a two mode optical fiber. When the optical fiber is surface mounted in a straight line and the object to which the optical fiber is mounted is subjected to strain within a predetermined range, the light intensity of any point at the output of the optical fiber will have a linear relationship to strain, provided the intermodal phase difference is less than 0.17 radians.

FAULT-TOLERANT FIBER OPTIC BACKPLANE Patent Application
A fault-tolerant, fiber optic interconnect, or backplane, which serves as a via for data transfer between modules is presented. Fault tolerance algorithms are embedded in the backplane by dividing the backplane into a read bus and a write bus and placing a redundancy management unit (RMU) between the read bus and the write bus so that all data transmitted by the write bus is subjected to the fault tolerance algorithms before the data is passed for distribution to the read bus. The RMU provides both backplane control and fault tolerance.

INAS HOLE-IMMOBILIZED DOPING SUPERLATTICE LONG-WAVE-INFRARED DETECTOR Patent

SOLID-STATE PHYSICS
Includes superconductivity.

INAS HOLE-IMMOBILIZED DOPING SUPERLATTICE LONG-WAVE-INFRARED DETECTOR Patent

Includes superconductivity.
An approach to long-wave-infrared (LWIR) technology is discussed. The approach is based on molecular beam epitaxy (MBE) growth of hole immobilized doping superlattices in narrow band gap 3-5 semiconductors, specifically, InAs and InSb. Such superlattices are incorporated into detector structures suitable for focal plane arrays. An LWIR detector that has high detectivity performance to wavelengths of about 16 microns at operating temperatures of 65K, where long-duration space refrigeration is plausible, is presented.

Gravitational phenomena, including convection, sedimentation, and interactions of materials with their containers all affect the crystal growth process. If they are not taken into consideration they can have adverse effects on the quantity and quality of crystals produced. As a practical matter, convection, and sedimentation can be completely eliminated only under conditions of low gravity attained during orbital flight. There is, then, an advantage to effecting crystallization in space. In the absence of convection in a microgravity environment cooling proceeds by thermal diffusion from the walls to the center of the solution chamber. This renders control of nucleation difficult.

Accordingly, there is a need for a new improved nucleation process in space. Crystals are nucleated by creating a small localized region of high relative supersaturation in a host solution at a lower degree of supersaturation.

Epitaxial heterojunctions formed between high temperature superconductors and metallic or semiconducting oxide barrier layers are provided. Metallic perovskites such as LaTiO₃, CaVO₃, and SrVO₃ are grown on electron-type high temperature superconductors such as Nd(1.85)Ce(0.15)CuO(4-x). Alternatively, transition metal bronzes of the form A(x)MO(3) are epitaxially grown on electron-type high temperature superconductors. Also, semiconducting oxides of perovskite-related crystal structures such as WO₃ are grown on either hole-type or electron-type high temperature superconductors.
A method and apparatus for controlling the crystallization of protein by solvent evaporation including placing a drop of protein solution between and in contact with a pair of parallel plates and driving one of the plates toward and away from the other plate in a controlled manner to adjust the spacing between the plates is presented. The drop of solution forms a liquid cylinder having a height dependent upon the plate spacing thereby effecting the surface area available for solvent evaporation. When the spacing is close, evaporation is slow. Evaporation is increased by increasing the spacing between the plates until the breaking point of the liquid cylinder. One plate is mounted upon a fixed post while the other plate is carried by a receptacle movable relative to the post and driven by a belt driven screw drive. The temperature and humidity of the drop of protein solution are controlled by sealing the drop within the receptacle and mounting a heater and dessicant within the receptacle.

NASA

A method for the controlled growth of single-crystal semiconductor-device-quality films of SiC polytypes on vicinal (0001) SiC wafers with low tilt angles is presented. Both homoeptaxial and heteroepitaxial SiC films can be produced on the same wafer. In particular, 3C-SiC and 6H-SiC films can be produced within selected areas of the same 6H-SiC wafer.

NASA
PUBLIC AVAILABILITY OF COPIES OF PATENTS AND PATENT APPLICATIONS

Copies of U.S. patents may be purchased directly from the U.S. Patent and Trademark Office, Washington, D.C. 20231 at $1.50 per copy. When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, preferably by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the Patent and Trademark Office.

NASA patent application specifications are sold in paper copy and microfiche by the NASA Center for AeroSpace Information (CASI). The N accession number should be used in ordering either paper copy or microfiche from CASI.

LICENSES FOR COMMERCIAL USE: INQUIRIES AND APPLICATIONS FOR LICENSE

NASA inventions, abstracted in NASA PAB, are available for nonexclusive or exclusive licensing in accordance with the NASA Patent Licensing Regulations. It is significant that all licenses for NASA inventions shall be by express written instruments and that no license will be granted or implied in a NASA invention except as provided in the NASA Patent Licensing Regulations.

Inquiries concerning the NASA Patent Licensing Program or the availability of licenses for the commercial use of NASA-owned inventions covered by U.S. patents or pending applications for patent should be forwarded to the NASA Patent Counsel of the NASA installation having cognizance of the specific invention, or the Associate General Counsel for Intellectual Property, code GP, National Aeronautics and Space Administration, Washington, D.C. 20546. Inquiries should refer to the NASA Case Number, the Title of the Invention, and the U.S. Patent Number or the U.S. Application Serial Number assigned to the invention as shown in NASA PAB.

The NASA Patent Counsel having cognizance of the invention is determined by the first three letters or prefix of the NASA Case Number assigned to the invention. The addresses of NASA Patent Counsels are listed alongside the NASA Case Number prefix letters in the following table.

STANDING ORDER SUBSCRIPTIONS

NASA SP-7039, Section 1 and its supplements are available from the NASA Center for AeroSpace Information on standing order subscription. Standing order subscriptions do not terminate at the end of a year, as do regular subscriptions, but continue indefinitely unless specifically terminated by the subscriber.
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<td>WOO-xxxxx</td>
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

14 CFR Part 1245

Licensing of NASA Inventions

AGENCY: National Aeronautics and Space Administration

ACTION: Interim regulation with comments requested.

SUMMARY: The National Aeronautics and Space Administration (NASA) is revising its patent licensing regulations to conform with Pub. L. 96-517. This interim regulation provides policies and procedures applicable to the licensing of federally owned inventions in the custody of the National Aeronautics and Space Administration, and implements Pub. L. 96-517. The object of this subpart is to use the patent system to promote the utilization of inventions arising from NASA supported research and development.

EFFECTIVE DATE: July 1, 1981. Comments must be received in writing by December 2, 1981. Unless a notice is published in the Federal Register after the comment period indicating changes to be made, this interim regulation shall become a final regulation.

ADDRESS: Mr. John G. Mannix, Director of Patent Licensing, GP-4, NASA, Washington, D.C. 20546

FOR FURTHER INFORMATION CONTACT: Mr. John G. Mannix, (202) 755-3954.

SUPPLEMENTARY INFORMATION:

PART 1245—PATENTS AND OTHER INTELLECTUAL PROPERTY RIGHTS

Subpart 2 of Part 1245 is revised to read as follows:

§1245.201 Policy and objective. It is the policy and objective of this subpart to use the patent system to promote the utilization of inventions arising from NASA supported research and development.

§1245.202 Definitions

(a) “Federal agency” means an executive department, military department, Government corporation, or independent establishment, except the Tennessee Valley Authority, which has custody of a Federally owned invention.

(b) “Federal agency” means an executive department, military department, Government corporation, or independent establishment, except the Tennessee Valley Authority, which has custody of a Federally owned invention.

(c) “NASA Invention” means a Federally owned invention with respect to which NASA maintains custody and administration; in whole or in part, of the right, title or interest in such invention on behalf of the United States Government.

(d) “Small business firm” means a small business concern as defined at section 3 of Pub. L. 85-536 (15 U.S.C. 632) and implementing regulations of the Administrator of the Small Business Administration. For the purpose of these regulations, the size standard for small business concerns involved in Government procurement, contained in 13 CFR 121.3-8, and in subcontracting, contained in 13 CFR 121.3-12, will be used.

(e) “Practical application” means to manufacture in the case of a composition or product, or practice in the case of a process or method, to operate in the case of a machine or system; and, in each case, under such condition, as to establish that the invention is being utilized and that its benefits are to the extent permitted by law or Government regulations available to the public on reasonable terms.

(f) “United States” means the United States of America, its territories and possessions, the District of Columbia, and the Commonwealth of Puerto Rico.

§1245.203 Authority to grant licenses. NASA inventions shall be made available for licensing as deemed appropriate in the public interest. NASA may grant nonexclusive, partially exclusive, or exclusive licenses thereto under this subpart on inventions in its custody.

Restrictions and Conditions

§1245.204 All licenses granted under this subpart.

(a) “Restrictions.” (1) A license may be granted only if the applicant has supplied NASA with a satisfactory plan for development or marketing of the invention, or both, and with information about the applicant’s capability to fulfill the plan.

(2) A license granting rights to use or sell under a NASA invention in the United States shall normally be granted only to a licensee who agrees that any products embodying the invention or produced through the use of the invention will be manufactured substantially in the United States.

(b) “Conditions.” Licenses shall contain such terms and conditions as NASA determines are appropriate for the protection of the interests of the Federal Government and the public and are not in conflict with law or this subpart. The following terms and conditions apply to any license:

(1) The duration of the license shall be for a period specified in the license agreement, unless sooner terminated in accordance with this subpart.

(2) The license may be granted for all or less than all fields of use of the invention or in specified geographical areas, or both.

(3) The license may extend to subsidiaries of the licensee or other parties if provided for in the license but shall be nonassignable without approval of NASA, except to the successor of that part of the licensee’s business to which the invention pertains.

(4) The license may provide the licensee the right to grant sublicenses under the license, subject to the approval of NASA. Each sublicense shall make reference to the license, including the rights retained by the Government, and a copy of such sublicense shall be furnished to NASA.

(5) The license shall require the licensee to carry out the plan for development or marketing of the invention, or both, to bring the invention to practical application within a period specified in the license, and to continue to make the benefits of the invention reasonably accessible to the public.
PATENT LICENSING REGULATIONS

(6) The license shall require the licensee to report periodically on the utilization or efforts at obtaining utilization that are being made by the licensee, with particular reference to the plan submitted.

(7) All licenses shall normally require royalties or other consideration.

(8) Where an agreement is obtained pursuant to § 1245.204(a)(2) that any products embodying the invention or produced through use of the invention will be manufactured substantially in the United States, the license shall recite such agreement.

(9) The license shall provide for the right of NASA to terminate the license, in whole or in part, if:
   (i) NASA determines that the licensee is not executing the plan submitted with its request for a license and the licensee cannot otherwise demonstrate to the satisfaction of NASA that it has taken or can be expected to take within a reasonable time effective steps to achieve practical application of the invention;
   (ii) NASA determines that such action is necessary to meet requirements for public use specified by Federal regulations issued after the date of the license and such requirements are not reasonably satisfied by the licensee;
   (iii) The licensee has willfully made a false statement of or willfully omitted a material fact in the license application or in any report required by the license agreement; or
   (iv) The licensee commits a substantial breach of a covenant or agreement contained in the license.

(10) The license may be modified or terminated, consistent with this subpart, upon mutual agreement of NASA and the licensee.

(11) Nothing relating to the grant of a license, nor the grant itself, shall be construed to confer upon any person any immunity from or defenses under the antitrust laws or from a charge of patent misuse, and the acquisition and use of rights pursuant to this subpart shall not be immunized from the operation of state or Federal law by reason of the source of the grant.

Types of Licenses

§ 1245.205 Nonexclusive licenses.

(a) Availability of licenses. Nonexclusive licenses may be granted under NASA inventions without publication of availability or notice of a prospective license.

(b) Conditions. In addition to the provisions of § 1245.204, the nonexclusive license may also provide that, after termination of a period specified in the license agreement, NASA may restrict the license to the fields of use or geographic areas, or both, in which the licensee has brought the invention to practical application and continues to make the benefits of the invention reasonably accessible to the public. However, such restriction shall be made only in order to grant an exclusive or partially exclusive license in accordance with this subpart.

§ 1245.206 Exclusive and partially exclusive licenses.

(a) Domestic licenses.

(1) Availability of licenses. Exclusive or partially exclusive licenses may be granted on NASA inventions: (i) 3 months after notice of the invention's availability has been announced in the Federal Register; or (ii) without such notice where NASA determines that expeditious granting of such a license will best serve the interests of the Federal Government and the public; and (iii) in either situation specified in (a)(1)(i) or (ii) of this section only if:
   (A) Notice of a prospective license, identifying the invention and the prospective licensee, has been published in the Federal Register, providing opportunity for filing written objections within a 60-day period; or
   (B) After expiration of the period in § 1245.206(a)(1)(ii)(A) and consideration of any written objections received during the period, NASA has determined that:
      (i) The interests of the Federal Government and the public will best be served by the proposed license, in view of the applicant's intentions, plans, and ability to bring the invention to practical application or otherwise promote the invention's utilization by the public;
      (ii) The desired practical application has not been achieved, or is not likely expeditiously to be achieved, under any nonexclusive license which has been granted, or which may be granted, on the invention;
      (iii) Exclusive or partially exclusive licensing is a reasonable and necessary incentive to call forth the investment of risk capital and expenditures to bring the invention to practical application or otherwise promote the invention's utilization by the public; and
      (d) The proposed terms and scope of exclusivity are not greater than reasonably necessary to provide the incentive for bringing the invention to practical application or otherwise promote the invention's utilization by the public;
      (C) NASA has not determined that the grant of such license will tend substantially to lessen competition or result in undue concentration in any section of the country in any line of commerce to which the technology to be licensed relates, or to create or maintain other situations inconsistent with the antitrust laws; and
      (D) NASA has given first preference to any small business firms submitting plans that are determined by the agency to be within the capabilities of the firms and as equally likely, if executed, to bring the invention to practical application as any plans submitted by applicants that are not small business firms.

(2) Conditions. In addition to the provisions of § 1245.204, the following terms and conditions apply to domestic exclusive and partially exclusive licenses:

   (i) The license shall be subject to the irrevocable, royalty-free right of the Government of the United States to practice and have practiced the invention on behalf of the United States and on behalf of any foreign government or international organization pursuant to any existing or future treaty or agreement with the United States.

   (ii) The license shall reserve to NASA the right to require the licensee to grant sublicenses to responsible applicants, on reasonable terms, when necessary to fulfill health or safety needs.

   (iii) The license shall be subject to any licenses in force at the time of the grant of the exclusive or partially exclusive license.

   (iv) The license may grant the licensee the right of enforcement of the licensed patent pursuant to the provisions of Chapter 29 of Title 35, United States Code, or other statutes, as determined appropriate in the public interest.

   (b) Foreign licenses.

   (1) Availability of licenses. Exclusive or partially exclusive licenses may be granted on a NASA invention covered by a foreign patent, patent application, or other form of protection, provided that:

        (i) Notice of a prospective license, identifying the invention and prospective licensee, has been published in the Federal Register, providing opportunity for filing written objections within a 60-day period and following consideration of such objections;

        (ii) NASA has considered whether the interests of the Federal Government or United States industry in foreign commerce will be enhanced; and

        (iii) NASA has not determined that the grant of such license will tend substantially to lessen competition or result in undue concentration in any section of the United States in any line of commerce to which the technology to be licensed relates, or to create or maintain other situations inconsistent with antitrust laws.

   (2) Conditions. In addition to the provisions of § 1245.204, the following terms and conditions apply to foreign exclusive and partially exclusive licenses:

        (i) The license shall be subject to the irrevocable, royalty-free right of the Government of the United States to practice and have practiced the invention on behalf of the United States and on behalf of any foreign government or international organization pursuant to any existing or future treaty or agreement with the United States.

        (ii) The license shall be subject to any licenses in force at the time of the grant of the exclusive or partially exclusive license.

        (iii) The license may grant the licensee the right to take any suitable and necessary actions to protect the licensed property, on behalf of the Federal Government.

        (c) Record of determinations. NASA shall maintain a record of determinations to grant exclusive or partially exclusive licenses.

Procedures

§ 1245.207 Application for a license.

An application for a license should be addressed to the Patent Counsel at the NASA installation having responsibility for the invention and shall normally include:

(a) Identification of the invention for which the license is desired, including the patent application serial number or patent number, title, and date, if known;

(b) Identification of the type of license for which the application is submitted;

(c) Name and address of the person, company, or organization applying for the license and the citizenship or place of incorporation of the applicant;

(d) Name, address, and telephone number of representative of applicant to whom correspondence should be sent;
(e) Nature and type of applicant's business, identifying products or services which the applicant has successfully commercialized, and approximate number of applicant's employees;

(f) Source of information concerning the availability of a license on the invention;

(g) A statement indicating whether applicant is a small business firm as defined in §1245.202(c);

(h) A detailed description of applicant's plan for development or marketing of the invention, or both, which should include:

(1) A statement of the time, nature and amount of anticipated investment of capital and other resources which applicant believes will be required to bring the invention to practical application;

(2) A statement as to applicant's capability and intention to fulfill the plan, including information concerning manufacturing, marketing, financial, and technical resources;

(3) A statement of the fields of use for which applicant intends to practice the invention;

(4) A statement of the geographic areas in which applicant intends to manufacture any products embodying the invention and geographic areas where applicant intends to use or sell the invention, if both;

(i) Identification of licenses previously granted to applicant under Federally owned inventions;

(j) A statement containing applicant's best knowledge of the extent to which the invention is being practiced by private industry or Government, or both, or is otherwise available commercially;

(k) Any other information which applicant believes will support a determination to grant the license to applicant.

§1245.208 Processing applications.

(a) Applications for licenses will be initially reviewed by the Patent Counsel of the NASA installation having responsibility for the invention. The Patent Counsel shall make a preliminary recommendation to the Director of Licensing, NASA Headquarters, whether to: (1) grant the license as requested, (2) grant the license with modification after negotiation with the licensee, or (3) deny the license. The Director of Licensing shall review the preliminary recommendation of the Patent Counsel and make a final recommendation to the NASA Assistant General Counsel for Patent Matters. Such review and final recommendation may include, and be based on, any additional information obtained from applicant and other sources that the Patent Counsel and the Director of Licensing deem relevant to the license requested. The determination to grant or deny the license shall be made by the Assistant General Counsel for Patent Matters based on the final recommendation of the Director of Licensing.

(b) When notice of a prospective exclusive or partially exclusive license is published in the Federal Register in accordance with §1245.206(a)(1)(ii)(A) or §1245.206(b)(1)(i), any written objections received in response thereto will be considered by the Director of Licensing in making the final recommendation to the Assistant General Counsel for Patent Matters.

(c) If the requested license, including any negotiated modifications, is denied by the Assistant General Counsel for Patent Matters, the applicant may request reconsideration by filing a written request for reconsideration within 30 days after receiving notice of denial. This 30-day period may be extended for good cause.

(d) In addition to, or in lieu of requesting reconsideration, the applicant may also appeal the denial of the license in accordance with §1245.211.

§1245.209 Notice to Attorney General.

A copy of the notice provided for in §§1245.206(a)(1)(ii)(A), and 1245.206(b)(1)(i) will be sent to the Attorney General.

§1245.210 Modification and termination of licenses.

Before modifying or terminating a license, other than by mutual agreement, NASA shall furnish the licensee and any sublicensee of record a written notice of intention to modify or terminate the license, and the licensee and any sublicensee shall be allowed 30 days after such notice to remedy any breach of the license or show cause why the license should not be modified or terminated.

§1245.211 Appeals.

(a) The following parties may appeal to the NASA Administrator or designee any decision or determination concerning the grant, denial, interpretation, modification, or termination of a license:
### Abstract

Abstracts are provided for 128 patents and patent applications entered into the NASA scientific and technical information system during the period January 1993 through June 1993. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application.
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