NASA SP-7039 (45)
July 1994

NASA PATENT ABSTRACTS
BIBLIOGRAPHY

A CONTINUING BIBLIOGRAPHY
SECTION 1 ABSTRACTS
The NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program plays a key part in helping NASA maintain this important role.

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NASA PATENT ABSTRACTS
BIBLIOGRAPHY

A CONTINUING BIBLIOGRAPHY
SECTION 1 INDEXES

National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC
1994
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 137 citations published in this issue of the Abstract Section cover the period January 1994 through June 1994. The Index Section references over 5600 citations covering the period May 1969 through June 1994.

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 back 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.
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## Section 1 • Abstracts

**AERONAUTICS** For related information see also Astronautics.

01 **AERONAUTICS (GENERAL)** ................................................................. N.A.

02 **AERODYNAMICS** ................................................................................. N.A.
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.

03 **AIR TRANSPORTATION AND SAFETY** ............................................ 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.

04 **AIRCRAFT COMMUNICATIONS AND NAVIGATION** ...................... 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.

05 **AIRCRAFT DESIGN, TESTING AND PERFORMANCE** ................. 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.

06 **AIRCRAFT INSTRUMENTATION** .......................................................... N.A.
Includes cockpit and cabin display devices; and flight instruments. For related information see also 19 Spacecraft Instrumentation and 35 Instrumentation and Photography.

07 **AIRCRAFT PROPULSION AND POWER** .......................................... 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.

08 **AIRCRAFT STABILITY AND CONTROL** ......................................... N.A.
Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also 05 Aircraft Design, Testing and Performance.

09 **RESEARCH AND SUPPORT FACILITIES (AIR)** .......................... N.A.
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).

**ASTRONAUTICS** For related information see also Aeronautics.

12 **ASTRONAUTICS (GENERAL)** .......................................................... N.A.
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13 **ASTRODYNAMICS** ........................................................................... N.A.
Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 **GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)** ........ 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).

15 **LAUNCH VEHICLES AND SPACE VEHICLES** .............................. N.A.
Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also 20 Spacecraft Propulsion and Power.

16 **SPACE TRANSPORTATION** .............................................................. 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.

17 **SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING** ............................................................................. 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.

N.A. — no abstracts were assigned to this category for this issue.
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37 MECHANICAL ENGINEERING ................................................................. 24
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38 QUALITY ASSURANCE AND RELIABILITY ........................................ 33
Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS ................................................................. 33
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) ................................................................. N.A.

43 EARTH RESOURCES AND REMOTE SENSING ................................... N.A.
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 ...................................... 34
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 28 Propellants and Fuels.

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

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

47 METEOROLOGY AND CLIMATOLOGY ............................................. N.A.
Includes weather forecasting and modification.

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

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52 AEROSPACE MEDICINE ................................................................. 35
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

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

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT .......................... 36
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.

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

MATHEMATICAL AND COMPUTER SCIENCES

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) .............. N.A.

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

61 COMPUTER PROGRAMMING AND SOFTWARE .................................. 37
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS .................................................................... 38
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 ......................................................................................................................... 47
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
A pattern of porous silicon is produced in the surface of a silicon substrate by forming a pattern of crystal defects in said surface, preferably by applying an ion milling beam through openings in a photoresist layer to the surface, and then exposing said surface to a stain etchant, such as HF:HNO₃:H₂O. The defected crystal will preferentially etch to form a pattern of porous silicon. When the amorphous content of the porous silicon exceeds 70 percent, the porous silicon pattern emits visible light at room temperature.
02 AERODYNAMICS

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

N94-10672* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

METHOD OF REDUCING DRAG IN AERODYNAMIC SYSTEMS Patent

In the present method, boundary layer thickening is combined with laminar flow control to reduce drag. An aerodynamic body is accelerated enabling a ram turbine on the body to receive air at velocity V sub 0. The discharge air is directed over an aft portion of the aerodynamic body producing boundary layer thickening. The ram turbine also drives a compressor by applying torque to a shaft connected between the ram turbine and the compressor. The compressor sucks in lower boundary layer air through inlets in the shell of the aircraft producing laminar flow control and reducing drag. The discharge from the compressor is expanded in a nozzle to produce thrust.

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

N94-11021* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.


A parachute having an improved vent line stacking wherein the parachute is provided with a canopy having a central vent opening and a vent band secured to the canopy around the periphery of the vent opening, with a plurality of vent lines each lying on a diameter of the vent opening and having its ends secured to the vent band on opposite sides of the vent opening is described. The vent lines are sewed to the vent band in an order such that the end of a first vent line is sewed to the vent band at a starting point with the end of a second vent band then being sewed to the vent band adjacent to and counterclockwise from the first band. A third vent band is sewed to the vent band adjacent to and clockwise from the first band, with a fourth vent band being sewed to the vent band adjacent to and counterclockwise from the second vent band. It can be seen that, if the vent lines are numbered in the order of being sewed to the vent band, each and every vent line will be separated from adjacent vent lines by no more than one vent line in the center of the vent opening described. With this order of assembly, each and every vent line will be sewed to the vent band adjacent to and clockwise from the starting point with the end of a first vent line. With this order of assembly, each and every vent line will be separated from adjacent vent lines by no more than one vent line in the center of the vent opening where the vent lines cross.

N94-10673* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

UNDERWING COMPRESSION VORTEX ATTENUATION DEVICE Patent

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 approxi-
08 AIRCRAFT STABILITY AND CONTROL

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and auto pilots.

N94-20555* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPARATUS AND METHOD FOR IMPROVING SPIN RECOVERY ON AIRCRAFT Patent


Previous research on airplane spinning and recovery has shown that at potential spin conditions (high angles of attack with rotation) the horizontal tail, depending upon its location, can create a wake about the vertical tail and rudder which can adversely affect airplane spin and recovery characteristics. Many methods of altering the tail geometry to modify these interference effects were investigated for improving airplane spin and recovery characteristics. Examples of changes includes relocation of the horizontal tail, increasing control surface travel, and use of a ‘flip tail’ that can be rotated to extreme angles for spin recovery. A device is provided which improves the spin recovery characteristics of aircraft which involves attaching the horizontal tail of the aircraft to the aircraft such that a gap remains between the root end of each horizontal tail section and the fuselage or vertical tail of the aircraft. The gaps measure between about 15 and 30 percent of the tail semispan. The gaps may be covered by shields which are released should a spin occur.

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

09 RESEARCH AND SUPPORT FACILITIES (AIR)

RESEARCH AND SUPPORT FACILITIES (AIR)

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

N94-10669* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

DYNAMIC TESTER FOR ROTOR SEALS AND BEARINGS Patent


A dynamic tester for testing vibration damping seals and bearings is constructed having a hollow shaft extending through the seal or bearing, with the shaft internally supported at each end by fluid bearings on hollow bosses connected to an interior of an enclosure, with no rolling members connected to the shaft is described. A high pressure working fluid is forced through the hollow bosses to operate the bearings. Additionally, the shaft is provided with a reaction turbine that angularly vents a portion of the high pressure working fluid in order to rotate the shaft at high speed, up to 40,000 rpm. The seal or bearing is mounted in a bushing, in turn supported by rods to a shaking device that vibrates the seal or bearing as the shaft is rotated. A plurality of proximity sensors are mounted from outside the enclosure to sense shaft and seal bushing vibrations, and a plurality of pressure ports are disposed in the enclosure to allow sensing of dynamic and static pressures of the testing apparatus.

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

N94-23310* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DEPLOYABLE VIDEO CONFERENCE TABLE Patent


A deployable table is presented. The table is stowed in and deployed from a storage compartment based upon a non-self rigidizing, 4-hinge, arch support structure that folds upon itself to stow and that expands to deploy. The work surfaces bypass each other above and below to allow the deployment mechanism to operate. This assembly includes the following: first and second primary pivot hinges placed at the opposite ends of the storage compartment; first and second lateral frame members with proximal ends connected to the first and second pivot hinges; a medial frame member offset from and pivotally connected to distal ends of the first and second members through third and fourth medial pivot hinges; and left-side, right-side, and middle trays connected respectively to
the first, second, and third frame members and being foldable into and out of the storage compartment by articulation of the first, second, third, and fourth joints. At least one of the third and fourth joints are locked to set the first, second, and third frame members in a desired angular orientation with respect to each other.

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

16 SPACE TRANSPORTATION

system connected to the supporting structure. The supporting structure is provided with bearing assemblies which are adapted to engage a supporting surface for permitting freedom of movement of the supporting structure over the supporting structure in any direction.

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

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

N94-20339* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

APPARATUS FOR SIMULATING AN EXOATMOSPHERIC STRUCTURE Patent


Apparatus for simulating an exoatmospheric structure, such as a spin stabilized satellite, in an environment subject to gravitational forces is presented. The apparatus includes a floating structure which is pivotally and rotationally supported upon a gimballed bearing structure positioned adjacent to the center of mass of the floating structure and suspended upon a support structure. The floating structure is translatable in either vertical direction relative to the supporting structure upon a vertically movable suspension system connected to the supporting structure. The supporting structure is provided with bearing assemblies which are adapted to engage a supporting surface for permitting freedom of movement of the supporting structure over the supporting structure in any direction.

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

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations, and space rescue techniques.

N94-20304* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

THERMALLY ACTIVATED RETAINER MEANS UTILIZING SHAPE MEMORY ALLOY Patent


A retainer member suitable for retaining a gap filler placed in gaps between adjacent tile members is presented. One edge of the retainer member may be attached to the gap filler and another edge may be provided with a plurality of tab members which in an intermediate position do not interfere with placement or removal of the gap filler between tile members. The retainer member may be fabricated from a shape memory alloy which when heated to a specified memory temperature will thermally activate the tab mem-
bers to predetermined memory positions engaging the tile members to retain the gap filler in the gap. This invention has particular application to the thermal tiles on space vehicles such as the Space Shuttle Orbiter.

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

APPARATUS AND METHOD FOR PRODUCING AN ARTIFICIAL GRAVITATIONAL FIELD Patent Application

An apparatus and method is disclosed for producing an artificial gravitational field in a spacecraft by rotating the same around a spin axis. The centrifugal force thereby created acts as an artificial gravitational force. The apparatus includes an engine which produces a drive force offset from the spin axis to drive the spacecraft towards a destination. The engine is also used as a counterbalance for a crew cabin for rotation of the spacecraft. Mass of the spacecraft, which may include either the engine or crew cabin, is shifted such that the centrifugal force acting on that mass is no longer directed through the center of mass of the craft. This off-center centrifugal force creates a moment that counterbalances the moment produced by the off-center drive force to eliminate unwanted rotation which would otherwise be precipitated by the offset drive force.

NASA

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.

N94-15935* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

APPARATUS AND METHOD FOR PRODUCING AN ARTIFICIAL GRAVITATIONAL FIELD Patent Application

An apparatus and method is disclosed for producing an artificial gravitational field in a spacecraft by rotating the same around a spin axis. The centrifugal force thereby created acts as an artificial gravitational force. The apparatus includes an engine which produces a drive force offset from the spin axis to drive the spacecraft towards a destination. The engine is also used as a counterbalance for a crew cabin for rotation of the spacecraft. Mass of the spacecraft, which may include either the engine or crew cabin, is shifted such that the centrifugal force acting on that mass is no longer directed through the center of mass of the craft. This off-center centrifugal force creates a moment that counterbalances the moment produced by the off-center drive force to eliminate unwanted rotation which would otherwise be precipitated by the offset drive force.

NASA

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.

N94-20367* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACE STATION TRASH REMOVAL SYSTEM Patent

A trash removal system for space stations is described. The system is comprised of a disposable trash bag member and an attached, compacted large, lightweight inflatable balloon element. When the trash bag member is filled, the astronaut places the bag member into space through an airlock. Once in the vacuum of space, the balloon element inflates. Due to the large cross-sectional area of the balloon element relative to its mass, the combined balloon element and the trash bag member are slowed by atmospheric drag to a much greater extent than the Space Station's. The balloon element and bag member lose altitude and re-enter the atmosphere, and the elements and contents are destroyed by aerodynamic heating. The novelty of this system is in the unique method of using the vacuum of space and aerodynamic heating to dispose of waste material with a minimum of increase in orbital debris.

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An apparatus and method is disclosed for decelerating and absorbing impact of a re-entry vehicle suitable for payloads that are relatively light as well as payloads weighing several tons or more. The apparatus includes four inflatable legs displaced equidistantly from each other around a capsule or housing which contains a payload. The legs are inflated at a designated altitude after entering earth's atmosphere to slow the descent of the re-entry vehicle. Connected between each of the four legs are drag inducing surfaces that deploy as the legs inflate. The drag inducing surfaces are triangularly shaped with one such surface being connected between each pair of legs for a total of six drag inducing surfaces. The legs have drag inducing outer surfaces which act to slow the descent of the re-entry vehicle.
negative coefficient of thermal expansion for at least a portion of the grid member's operative range of use.

A method of forming a shock-free supersonic elliptic nozzle, in which the nozzle to be designed is divided into three sections, a circular-to-elliptic section which begins at a circular nozzle inlet, an elliptic subsonic section downstream from the circular-to-elliptic section, and a supersonic section downstream from the elliptic subsonic section is described. The maximum and minimum radii for each axial point in the circular-to-elliptic section and the elliptic subsonic section are then separately determined, the maximum and minimum radii being the radii for the widest part of an elliptic cross-section and the narrowest part of the elliptic cross-section, respectively. The maximum and minimum radii for each axial point in the supersonic section are determined based on the Method of Characteristics. Then, each of the three sections are based on the maximum and minimum radii for each axial point in the section. The resulting nozzle is acoustically superior.
rocket engine of the bipropellant type is provided which includes tangential fuel metering orifices, and a plurality of oxidizer tube injection elements whose injection tubes are also provided with tangential oxidizer entry slots and internal reed valves.

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SEGMENTED ION THRUSTER Patent

Apparatus and methods for large-area, high-power ion engines comprise dividing a single engine into a combination of smaller discharge chambers (or segments) configured to operate as a single large-area engine. This segmented ion thruster (SIT) approach enables the development of 100-kW class argon ion engines for operation at a specific impulse of 10,000 s. A combination of six 30-cm diameter ion chambers operating as a single engine can process over 100 kW. Such a segmented ion engine can be operated from a single power processor unit.

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

POLYBENZOXAZOLE VIA AROMATIC NUCLEOPHILIC DISPLACEMENT Patent

Polybenzoxazoles (PBO) are heterocyclic macromolecules which were first synthesized in a two-step process by the initial formation of aromatic diacid chlorides with bis(o-aminophenol)s through solution condensation of aromatic diacid chlorides with bis(o-aminophenol)s followed by thermal cyclodehydration. Since then several methods were utilized in their synthesis. The most common synthetic method for PBO involves a polycondensation of bis(o-aminophenol)s with aromatic diacid diphenyl esters. Another preparative route involves the solution polycondensation of the hydrochloride salts of bis(o-aminophenol)s with aromatic diacids in polyphosphoric acid. Another synthetic method involves the initial formation of poly(o-hydroxy amide)s from silylated bis (o-aminophenol)s with aromatic diacid chlorides followed by thermal cyclodehydration to PBO. A recent preparative route involves the reaction of aromatic bisphenols with bis(fluorophenyl) benzoxazoles by the displacement reaction to form PBO. The novelty of the present invention is that high molecular weight PBO of new chemical structures are prepared that exhibit a favorable combination of physical and mechanical properties.

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METHOD AND APPARATUS FOR NON-DESTRUCTIVE EVALUATION OF COMPOSITE MATERIALS WITH CLOTH SURFACE IMPRESSIONS Patent Application

A method and related apparatus for non-destructive evaluation of composite materials by determination of the quantity known as Integrated Polar Backscatter, which avoids errors caused by surface texture left by cloth impressions by identifying frequency...
ranges associated with peaks in a power spectrum for the backscattered signal, and removing such frequency ranges from the calculation of Integrated Polar Backscatter for all scan sites on the composite material is presented.

A SrO-Al2O3 - 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. Organic constituents are burned out of the ‘green’ composite, and the remaining interim material is hot pressed.
**27 NONMETALLIC MATERIALS**

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

**N94-15879** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**COMPOUNDS CONTAINING META-BIPHENYLENEDIOXY MOIETIES AND POLYMERS THEREFROM Patent Application**

TERRY L. ST.CLAIR, inventor (to NASA) and JOHN RICHARD PRATT, inventor (to NASA) (Lockheed Engineering and Sciences Co., Hampton, VA.) 13 May 1993 16 p


Two monomers containing meta-biphenylenedioxy moieties were prepared. One monomer, a diamine, is used to prepare polyimide, polyamide, and epoxy polymers. The other monomer, a dianhydride, was used to prepare polyimide polymers. These polymers are used to make films, coatings, and selective membranes.

**N94-15880** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**STRUCTURES FROM LOW DIELECTRIC POLYIMIDES Patent Application**

ANNE K. ST.CLAIR, inventor (to NASA), TERRY L. ST.CLAIR, inventor (to NASA), and WILLIAM P. WINFREE, inventor (to NASA) 28 Sep. 1992 31 p


A structure which is effective as an electrical insulator or as a transmitter-receiver of electromagnetic energy is prepared by providing a suitable substrate and covering the substrate with an adhering layer of a low dielectric, high temperature, linear aromatic polyimide. This polyimide is prepared by selecting aromatic diamine and aromatic dianhydride reactants to meet at least two of the following three conditions: a reactant must have minimal permanent or inducible electrical dipolar characteristics as a result of the presence of pendant or bridging groups therein, a reactant must impart a high degree of free volume to the polymer caused by inefficient chain packing therein in the solid state as a result of the presence of pendant or bridging groups therein, and a reactant must have fluorine atoms chemically attached thereto; and chemically combining equimolar quantities of the aromatic diamine and aromatic dianhydride reactants in a solvent to form a high molecular weight polyamic acid solution, and converting the high molecular weight polyamic acid to the corresponding low dielectric, high temperature linear aromatic polyimide.

**N94-15930** National Aeronautics and Space Administration. Pasadena Office, CA.

**CYANOESIN, CYANOESIN/CELLULOSE TRIACETATE BLENDS FOR THIN FILM, DIELECTRIC CAPACITORS Patent Application**

SHIAO-PING YEN, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 28 May 1993 17 p

(Contract NAS7-918)


Non-brittle dielectric films are formed by blending a cyanoresin such as cyanoethyl, hydroxyethyl cellulose (CRE) with a compatible, more crystalline resin such as cellulose triacetate. The electrical breakdown strength of the blend is increased by orienting the films by uniaxial or biaxial stretching. Blends of high molecular weight CRE with high molecular weight cyanoethyl cellulose (CRC) provide films with high dielectric constants.

**N94-15960** National Aeronautics and Space Administration. Pasadena Office, CA.

**SELECTIVE FORMATION OF POROUS SILICON Patent Application**

JONES FATHAUER, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 7 Jun. 1993 16 p

(Contract NAS7-918)


A pattern of porous silicon is produced in the surface of a silicon substrate by forming a pattern of crystal defects in said surface, preferably by applying an ion milling beam through openings in a photosist layer to the surface, and then exposing said surface to a stain etchant, such as HF:HNO3:H2O. The defected crystal will preferentially etch to form a pattern of porous silicon. When the amorphous content of the porous silicon exceeds 70 percent, the porous silicon pattern emits visible light at room temperature.
A series of polyimides based on the dianhydride of 1,4-bis(3,4-dicarboxyphenoxy) benzene (HQDEA) or on 2,2-bis(4-aminophenoxy phenyl)hexafluoropropane (3-BDAF) are evolved from high molecular weight polyamic acid solutions yielding flexible free-standing films and coatings in the fully imidized form which have a dielectric constant in the range of 2.5 to 3.1 at 10 GHz.

The use of guanidine salts of organic fatty acids (guanidine soaps) as vehicles and binders for coating substrate surfaces is disclosed. Being completely organic, the guanidine soaps can be burned off leaving no undesirable residue. Of special interest is the use of guanidine 2-ethyl hexanoate as the vehicle and binder for coating problematic surfaces such as in coating alumina fibers with platinum or zirconia. For this application, the guanidine soap is used as a melt. For applications, the guanidine soap may be use in a solution with a variety of solvents, the solution containing chlorometalates or powdered metals, refractories, or ceramics.

This invention is a robotic joint which is operated by inflatable bladders and which can be used in applications where it is desired to move or hold an object. A support block supports an elongated plate to which is pivotally attached a finger. A tension strip passes over a lever attached to the finger and is attached at its ends to the support block on opposite sides of the plate. Bladders positioned between the plate and the tension strip on opposite sides of the plate can be inflated by pumps to pivot the finger, with one of the bladders being inflated while the other is being deflated.

An assembly of an article and a polyimide is prepared. The assembly resists dimensional change, delamination, or debonding when exposed to changes in temperature.

An process for preparing an assembly of an article and a soluble polyimide which resists dimensional change, delamination, and debonding when exposed to changes in temperature.

An assembly of an article and a polyimide is prepared. The assembly resists dimensional change, delamination, or debonding when exposed to changes in temperature. An article is provided. A soluble polyimide resin solution having a low coefficient of thermal
expansion (CTE) was prepared by dissolving the polyimide in solvent and adding a metal ion-containing additive to the solution. Examples of the additive are Ho(OOCCH3)3, Er(NPPA)3, TmCl3, and Er(C5H7O2)3. The soluble polyimide resin is combined with the article to form the assembly.

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

N94-20374* National Aeronautics and Space Administration.
Langley Research Center, Hampton, VA.

POLYIMIDES CONTAINING AMIDE AND PERFLUOROISOPROPYLIDENE CONNECTING GROUPS

Patent

New, thermooxidatively stable polyimides were prepared from the reaction of aromatic dianhydrides containing isopropylidene bridging groups with aromatic diamines containing amide connecting groups between the rings. Several of these polyimides were shown to be semi-crystalline as evidenced by wide angle x ray scattering and differential scanning calorimetry. Most of the polyimides form tough, flexible films with high tensile properties. These polyimide films exhibit enhanced solubility in organic solvents.

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N94-20377* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

IMPROVED CERAMIC SLIP CASTING TECHNIQUE Patent

A primary concern in modern fluid dynamics research is the experimental verification of computational aerothermodynamic codes. This research requires high precision and detail in the test model employed. Ceramic materials are used for these models because of their low heat conductivity and their survivability at high temperatures. To fabricate such models, slip casting techniques were developed to provide net-form, precision casting capability for high-purity ceramic materials in aqueous solutions. In previous slip casting techniques, block, or flask molds made of plaster-of-paris were used to draw liquid from the slip material. Upon setting, parts were removed from the flask mold and cured in a kiln at high temperatures. Casting detail was usually limited with this technique - detailed parts were frequently damaged upon separation from the flask mold, as the molded parts are extremely delicate in the uncured state, and the flask mold is inflexible. Ceramic surfaces were also marred by 'parting lines' caused by mold separation. This adversely affected the aerodynamic surface quality of the model as well. (Parting lines are invariably necessary on or near the leading edges of wings, nosetips, and fins for mold separation. These areas are also critical for flow boundary layer control.) Parting agents used in the casting process also affected surface quality. These agents eventually soaked into the mold, the model, or flaked off when releasing the case model. Different materials were tried, such as oils, paraffin, and even an algae. The algae released best, but some of it remained on the model and imparted an uneven texture and discoloration on the model surface when cured. According to the present invention, a wax pattern for a shell mold is provided, and an aqueous mixture of a calcium sulfate-bonded investment material is applied as a coating to the wax pattern. The coated wax pattern is then dried, followed by curing to vaporize the wax pattern and leave a shell mold of the calcium sulfate-bonded investment material. The shell mold is cooled to room temperature, and a ceramic slip is poured therein. After a ceramic shell of desired thickness has set up in the shell mold, excess ceramic slip is poured out. While still wet, the shell mold is peeled from the ceramic shell to expose any delicate or detailed parts, after which the ceramic shell is cured to provide a complete, detailed, precision ceramic article without parting lines.

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N94-20529* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SINTERING SILICON NITRIDE Patent

Oxides having a composition of (Ba1-xSr(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.

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

N94-20541* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

METHOD OF FABRICATING A ROCKET ENGINE COMBUSTION CHAMBER Patent

The present invention is a method of fabricating a rocket engine combustion chamber. The method involves the use of pressure casting to produce a combustible chamber assembly. The assembly comprises a metallic shell and a ceramic shell. The metallic shell is formed by casting a molten metal into a mold. The ceramic shell is formed by casting a ceramic slip into a mold. The ceramic slip is a mixture of a ceramic powder and a liquid binder. The liquid binder is an aqueous solution of a calcium sulfate-bonded investment material. The ceramic slip is poured into a mold and allowed to set. The mold is then dried, followed by curing to vaporize the wax pattern and leave a ceramic shell of desired thickness. The ceramic shell is then cooled to room temperature, and a ceramic slip is poured therein. After a ceramic shell of desired thickness has set up in the shell mold, excess ceramic slip is poured out. While still wet, the shell mold is peeled from the ceramic shell to expose any delicate or detailed parts, after which the ceramic shell is cured to provide a complete, detailed, precision ceramic article without parting lines.

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27 NONMETALLIC MATERIALS
A process for making a combustion chamber for a rocket engine wherein a copper alloy in particle form is injected into a stream of heated carrier gas in plasma form which is then projected onto the inner surface of a hollow metal jacket having the configuration of a rocket engine combustion chamber is described. The particles are in the plasma stream for a sufficient length of time to heat the particles to a temperature such that the particles will flatten and adhere to previously deposited particles but will not spatter or vaporize. After a layer is formed, cooling channels are cut in the layer, then the channels are filled with a temporary filler and another layer of particles is deposited.

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A process for preparing polyimides having enhanced melt flow properties is described. The process consists of heating a mixture of a high molecular weight poly-(amidic acid) or polyimide with a low molecular weight amidic acid or imide additive in the range of 0.05 to 15 percent by weight of the additive. The polyimide powders so obtained showed improved processability, as evidenced by lower melt viscosity by capillary rheometry. Likewise, films prepared from mixtures of polyimides with additives showed improved processability with earlier onset of stretching by TMA.

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Aromatic dihalides.

Di(hydroxyphenyl)-1,2,4-triazole monomers were prepared from phenyl-hydroxybenzoate and aromatic bis(o-diamine)s. These monomers were used in the synthesis of soluble polybenzimidazoles. The reaction involved the aromatic nucleophilic displacement of di(hydroxyphenyl)-1,2,4-triazole monomers.
various di(hydroxyphenyl)benzimidazole monomers with activated aromatic dihalides or activated aromatic dinitro compounds in the presence of an alkali metal base. These polymers exhibited lower glass transition temperatures, improved solubility, and better compression moldability over their commercial counterparts.

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Novel high strength ceramic fibers derived from boron, silicon, and carbon organic precursor polymers are discussed. The ceramic fibers are thermally stable up to and beyond 1200 °C in air. The method of preparation of the boron-silicon-carbon fibers from a low oxygen content organosilicon boron precursor polymer of the general formula Si(R2)BR(1) includes melt-spinning, crosslinking, and pyrolysis. Specifically, the crosslinked (or cured) precursor organic polymer fibers do not melt or deform during pyrolysis to form the silicon-boron-carbon ceramic fibers. These novel silicon-boron-carbon ceramic fibers are useful in high temperature applications because they retain tensile and other properties up to 1200 °C, from 1200 to 1300 °C, and in some cases higher than 1300 °C.

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


A process for slip casting ceramic articles that does not employ parting agents and affords the casting of complete, detailed, precision articles that do not possess parting lines is presented. This process is especially useful for high temperature superconductors and water-sensitive ceramics. A wax pattern for a shell mold is provided, and an aqueous mixture of a calcium sulfate-bonded investment material is applied as a coating to the wax pattern. The coated wax pattern is then dried, followed by curing to vaporize the wax pattern and leave a shell mold of the calcium sulfate-bonded investment material. The shell mold is cooled to room temperature, and a ceramic slip, created by dispersing a ceramic powder in an organic liquid, is poured therein. A ceramic shell of desired thickness or a solid article has set up in the shell mold, excess organic liquid, is poured therein. After a ceramic shell is poured out. The shell mold is misted with water and peeled away from the ceramic article, after which the ceramic is fired to provide a complete, detailed, precision, high temperature superconductive ceramic article without parting lines. The casting technique may take place in the presence of a magnetic field to orient the ceramic powders during the casting process.


Includes radar; land and global communications; communications theory; and optical communications.

32 COMMUNICATIONS AND RADAR

N94-20368∗ National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLEXIBLE HEATING HEAD FOR INDUCTION HEATING Patent

An induction heating head includes a length of wire having first and second opposite ends and being wound in a flat spiral shape to form an induction coil, a capacitor connected to the first and second ends of the wire, the induction coil and capacitor defining a tank circuit, and a flexible, elastomeric body molded to encase the induction coil. When a susceptor is placed in juxtaposition to the body, and the tank circuit is powered, the susceptor is inductively heated.

ELECTRONICS AND ELECTRICAL ENGINEERING

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

METHOD FOR PRODUCING A HYBRIDIZATION OF DETECTOR ARRAY AND INTEGRATED CIRCUIT FOR READOUT Patent

A process is explained for fabricating a detector array in a layer of semiconductor material on one substrate and an integrated readout circuit in a layer of semiconductor material on a separate substrate in order to select semiconductor material for optimum performance of each structure, such as GaAs for the detector array and Si for the integrated readout circuit. The detector array layer is lifted off its substrate, laminated on the metallized surface on the integrated surface, etched with reticulating channels to the surface of the integrated circuit, and provided with interconnections between the detector array pixels and the integrated readout circuit through the channels. The adhesive material for the lamination is
selected to be chemically stable to provide electrical and thermal insulation and to provide stress release between the two structures fabricated in semiconductor materials that may have different coefficients of thermal expansion.

fields cancel each other, therefore light on the optical path does not read the effect of either. However, when a ground fault occurs, the optical path is exposed to a net Faraday effect rotation due to the current imbalance thereby exposing the ground fault.
Very thin films of cellulose triacetate are cast from a solution containing a small amount of high boiling temperature, non-solvent which evaporates last and lifts the film from the casting surface. Stretched, oriented, crystallized films have high electrical breakdown properties. Metallized films less than about 2 microns in thickness form self-healing electrodes for high energy density, pulsed power capacitors. Thicker films can be utilized as a dielectric for a capacitor.

A device for testing current paths is attachable to a conductor. The device automatically checks the current paths of the conductor for continuity of a center conductor, continuity of a shield, and a short circuit between the shield and the center conductor. The device includes a pair of connectors and a circuit to provide for testing of the conductive paths of a cable to be tested with the circuit paths of the circuit. The circuit paths in the circuit include indicators to simultaneously indicate the results of the testing.

A submillimeter wave-generating integrated circuit includes an array of N photoconductive switches biased across a common voltage source and an optical path difference from a common optical pulse of repetition rate $f_{sub}$ providing a different optical delay to each of the switches. In one embodiment, each incoming pulse is applied to successive ones of the N switches with successive delays. The N switches are spaced apart with a suitable switch-to-switch spacing so as to generate at the output load or antenna radiation of a submillimeter wave frequency $f_{sub}$ on the order
of Nf sub 0. Preferably, the optical pulse has a repetition rate of at least 10 GHz and N is of the order of 100, so that the circuit generates radiation of frequency of the order of or greater than 1 Terahertz.
The invention relates to planar varactor frequency multiplier devices with a heterojunction blocking barrier for near millimeter wave radiation of moderate power from a fundamental input wave. The space charge limitation of the submillimeter frequency multiplier devices of the BNN\(^{+}\) type is overcome by a diode structure comprising an n\(^{+}\) doped layer of semiconductor material functioning as a low resistance back contact, a layer of semiconductor material with n-type doping functioning as a drift region grown on the back contact layer, a delta doping sheet forming a positive charge at the interface of the drift region layer with a barrier layer, and a surface metal contact. The layers thus formed on an n\(^{+}\) doped layer may be divided into two isolated back-to-back BNN\(^{+}\) diodes by separately depositing two surface metal contacts. By repeating the sequence of the drift region layer and the barrier layer with the delta doping sheet at the interfaces between the drift and barrier layers, a plurality of stacked diodes is formed. The novelty of the invention resides in providing n-type semiconductor material for the drift region in a GaAs/AIGaAs structure, and in stacking a plurality of such BNN\(^{+}\) diodes stacked for greater output power with and connected back-to-back with the n\(^{+}\) GaAs layer as an internal back contact and separate metal contact over an AIGaAs barrier layer on top of each stack.

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 Li\(_2\)Mn\(_2\)O\(_4\) and Li\((0.1)\)Mo\(_2\)O\(_4\).

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An apparatus and method is disclosed for regulating flow of working fluid through parallel condensation tubes requiring subcooling. The apparatus provides an elongated restriction element extending into the outlet of the respective condensation tubes to the approximate point of onset of subcooling. The elongated restriction element has a pentagonal cross-section and is slightly elongated.
undersized with respect to the working fluid passageways through the condensation tubes. The restriction member significantly restricts flow of partially vaporized working fluid but does not significantly affect the flow of fully liquid working fluid.

N94-20361* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPIRAL FLUID SEPARATOR Patent

A fluid separator for separating particulate matter such as contaminants 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.

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N94-20371* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COOLING APPARATUS AND COUPLINGS THEREFOR Patent

The present invention relates generally to the field of thermal transfer and, more specifically, to a direct-interface, fusible heat sink for non-venting, regenerable, and self-contained thermal regulation. A quick connect coupling includes a male and a female portion. The female portion is frozen in a container of solid-phase coolant fluid, i.e., water, so that passages in the housing are blocked by ice initially. The ice is melted by direct interface with liquid coolant fluid delivered from the male portion. The present invention has advantages in that the phase change material remains sealed at all times, including during regeneration. Also, it uses quick-disconnect couplings that allow the phase change material to completely fill the container and is easily handled in microgravity without spills, leakage, or handling of phase change material.

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N94-20495* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HEAT EXCHANGER WITH OSCILLATING FLOW Patent

Various heat exchange apparatuses are described in which an oscillating flow of primary coolant is used to dissipate an incident heat flux. The oscillating flow may be imparted by a reciprocating piston, a double action twin reciprocating piston, fluidic oscillators or electromagnetic pumps. The oscillating fluid flows through at least
one conduit in either an open loop or a closed loop. A secondary flow of coolant may be used to flow over the outer walls of at least one conduit to remove heat transferred from the primary coolant to the walls of the conduit.

N94-20588* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

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

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 and 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.

N94-2306* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PROBE SYSTEMS FOR MEASURING STATIC PRESSURE AND TURBULENCE INTENSITY IN FLUID STREAMS Patent

A method and apparatus for directly measuring the time-averaged streamwise momentum in a turbulent stream use a probe which has total head response which varies as the cosine-squared of the angle of incidence. The probe has a nose with a slight indentation on its front face for providing the desired response. The method of making the probe incorporates unique design features. Another probe may be positioned in a side-by-side relationship to the first probe to provide a direct measurement of the total pressure. The difference between the two pressures yields the sum of the squares of the cross-stream components of the turbulence level.

N94-23077* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PROBE SHAPES THAT MEASURE TIME-AVERAGED STREAMWISE MOMENTUM AND CROSS-STREAM TURBULENCE INTENSITY Patent

A method and apparatus for directly measuring the time-averaged streamwise momentum in a turbulent stream use a probe which has total head response which varies as the cosine-squared of the angle of incidence. The probe has a nose with a slight indentation on its front face for providing the desired response. The method of making the probe incorporates unique design features. Another probe may be positioned in a side-by-side relationship to the first probe to provide a direct measurement of the total pressure. The difference between the two pressures yields the sum of the squares of the cross-stream components of the turbulence level.
teristics of the fluid stream, preferably as a result of having varying cross sections. The responses from the probes are used to eliminate unwanted components in the measured quantities for accurate determination of selected characteristics.

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

N94-15872*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CAPACIFLECTOR CAMERA Patent Application
JOHN M. VRANISH, inventor (to NASA) 12 Jul. 1993 39 p
A capacitive type proximity sensor having improved range and sensitivity between a surface and an intruding object in the vicinity of the surface having a voltage source, a number of outer electrical conductors on the surface with each forming one electrode of a number of sensor capacitors, the other electrode for each sensor capacitor being the object is described. The outer conductors are made from thin sheets of conductive material covered with insulation. An intermediate electrical conductor is located between the outer conductors and the surface and is of a size larger than the outer conductors to act as a shield for reducing the parasitic capacitance between the outer conductors and the surface. The intermediate conductor is also made from a thin sheet of conductive material covered with insulation. The outer conductors and the intermediate conductor are attached to the surface with no gap between the insulation on the conductors and no gap between the surface and the insulation on intermediate conductor, the outer conductors and the intermediate conductor conjoining with each other and with the surface, with the surface acting as a ground plane. A current-measuring voltage follower circuit is connected to the voltage source for coupling in phase and amplitude the instantaneous voltage at the voltage source to the outer electrical conductors and the intermediate electrical conductor. This circuit is responsive to the change in capacitance of the sensor capacitors and generates a number of output signals.

NASA

N94-15875*# National Aeronautics and Space Administration. Pasadena Office, CA.
SUPERCONDUCTIVE MATERIAL AND MAGNETIC FIELD FOR DAMPING AND LEVITATION SUPPORT AND DAMPING OF CRYOGENIC INSTRUMENTS Patent Application
(Contract NAS7-918)
A superconductive load bearing support without a mechanical contact and vibration damping for cryogenic instruments in space is presented. The levitation support and vibration damping is accomplished by the use of superconducting magnets and the 'Meissner' effect. The assembly allows for transfer of vibration energy away from the cryogenic instrument which then can be damped by the use of either an electronic circuit or conventional vibration damping mean.

NASA
A pulse phase locked loop system according to the present invention is described. A frequency generator such as a voltage controlled oscillator (VCO) generates an output signal and a reference signal having a frequency equal to that of the output signal. A transmitting gate gates the output frequency signal and this gated signal drives a transmitting transducer which transmits an acoustic wave through a material. A sample/hold samples a signal indicative of the transmitted wave which is received by a receiving transducer. Divide-by-n counters control these gating and sampling functions in response to the reference signal of the frequency generator. Specifically, the output signal is gated at a rate of \( F/h \), wherein \( F \) is the frequency of the output signal and \( h \) is an integer; and the received signal is sampled at a delay of \( F/n \) wherein \( n \) is an integer.

A remote tire pressure sensing technique is provided which uses vibration frequency to determine tire pressure. A vibration frequency measuring device is attached to the external surface of a tire which is then struck with an object, causing the tire to vibrate. The frequency measuring device measures the vibrations and converts the vibrations into corresponding electrical impulses. The electrical impulses are then fed into the frequency analyzing system which uses the electrical impulses to determine the relative peaks of the vibration frequencies as detected by the frequency measuring device. The measured vibration frequency peaks are then compared to predetermined data describing the location of vibration frequency peaks for a given pressure, thereby determining the air pressure of the tire.
A method for producing a phase hologram using e-beam lithography provides n-ary levels of phase and amplitude by first producing an amplitude hologram on a transparent substrate by e-beam exposure of a resist over a film of metal by exposing \( n \leq m \times m \) spots of an array of spots for each pixel, where the spots are randomly selected in proportion to the amplitude assigned to each pixel, and then after developing and etching the metal film producing a phase hologram by e-beam lithography using a low contrast resist, such as PMMA, and n-ary levels of low doses less than approximately 200 micro-C/sq cm and preferably in the range of 20-200 micro-C/sq cm and aggressive development using pure acetone for an empirically determined time (about 6 sec.) controlled to within 1/10 sec. to produce partial development of each pixel in proportion to the n-ary level of dose assigned to it.

A thermocouple is disclosed. The thermocouple is comprised of an electropositive leg formed of a noble metal-Al alloy and an electronegative leg electrically joined to form a thermocouple junction. The thermocouple provides for accurate and reproducible measurement of high temperatures (600 - 1300°C) in inert, oxidizing or reducing environments, gases, or vacuum. Furthermore, the thermocouple circumvents the need for expensive, strategic precious metals such as rhodium as a constituent component. Selective oxidation of rhodium is also thereby precluded.

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**FIG. 2**

LOW POWER CURRENT CONTROL SOURCE

PUMP SOURCE

DIODE LASER

LASER MEDIUM

Q SWITCH

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A technique was developed which carefully retro-reflects precisely controlled amounts of light back into a laser system thereby intentionally forcing the laser system components to oscillate in a new resonator called the parasitic oscillator. The parasitic oscillator uses the laser system to provide the gain and an external mirror is used to provide the output coupling of the new resonator. Any change of gain or loss inside the new resonator will directly change the lasing threshold of the parasitic oscillator. This change in threshold can be experimentally measured as a change in the absolute value of reflectivity, provided by the external mirror, necessary to achieve lasing in the parasitic oscillator. Discrepancies between experimental data and a parasitic oscillator model are direct evidence of optical misalignment or component performance problems. Any changes in the optical system can instantly be measured as a change in threshold for the parasitic oscillator. This technique also enables aligning the system for maximum parasitic suppression with the system fully operational.

Two types of systems for force-reflecting control, which enables high force-reflection gain, are presented: position-error-based force reflection and low-pass-filtered force reflection. Both of the systems are combined with shared compliance control. In the position-error-based class, the position error between the commanded and the actual position of a compliantly controlled robot is used to provide force reflection. In the low-pass-filtered force reflection class, the low-pass-filtered output of the compliance control is used to provide force reflection. The increase in force reflection gain can be more than 10-fold as compared to a conventional high-bandwidth pure force reflection system, when high compliance values are used for the compliance control.

An inline check valve for a flow line is presented where the valve element is guided for inline travel forward and rearward of a valve sealing member and is spring biased to a closed sealing condition. One of the guides for the valve element includes a dashpot bore and plunger member to control the rate of travel of the valve element in either direction as well as provided a guiding function. The dashpot is not anchored to the valve body so that the valve can be functional even if the plunger member becomes jammed in the dashpot.

**MECHANICAL ENGINEERING**

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

**FORCE REFLECTION WITH COMPLIANCE CONTROL**

37 MECHANICAL ENGINEERING

N94-10658 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CHECK VALVE WITH POPPET DASHPOT/FRICIONAL DAMPING MECHANISM Patent

An inline check valve for a flow line where the valve element is guided for inline travel forward and rearward of a valve sealing member and is spring biased to a closed sealing condition is presented. One of the guides for the valve element includes a dashpot housing with a bore and plunger member to control the rate of travel of the valve element in either direction, providing a guiding function. The plunger member is arranged with a dashpot ring to frictionally contact the dashpot bore and has an interior tortuous flow path from one side to the other side of the dashpot ring. The dashpot housing is not anchored to the valve body so that the valve can be functional even if the dashpot ring becomes jammed in the dashpot housing.

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

N94-10670 National Aeronautics and Space Administration, Pasadena Office, CA.
TELEROBOT CONTROL SYSTEM Patent

This invention relates to an operator interface for controlling a telerobot to perform tasks in a poorly modeled environment and/or within unplanned scenarios. The telerobot control system includes a remote robot manipulator linked to an operator interface. The operator interface includes a setup terminal, simulation terminal, and execution terminal for the control of the graphics simulator and local robot actuator as well as the remote robot actuator. These terminals may be combined in a single terminal. Complex tasks are developed from sequential combinations of parameterized task primitives and recorded teleoperations, and are tested by execution on a graphics simulator and/or local robot actuator, together with adjustable time delays. The novel features of this invention include the shared and supervisory control of the remote robot manipulator via operator interface by pretested complex task sequences based on sequences of parameterized task primitives combined with further teleoperation and run-time binding of parameters based on task context.

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

N94-10674 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COOLED SPOOL PISTON COMPRESSOR Patent

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.

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

A releasable coupling device for connecting two members to one another where a collet type fastener has normally retracted latching fingers insertable into a latching recess and a longitudinally movable expander for activating the fastener is described. The longitudinal movement is retained with a paraffin actuated system which can reset. The longitudinal movement of the expander in one direction is through a one way threaded ratchet system which provides an automatic locking action and the expander is movable in either direction by an independently operated threaded action.

An apparatus is disclosed for capturing and holding a rod, bar or similar member; the apparatus having in one aspect a body member with a recess therein and a hook extending from the body member, the hook and recess defining a capture envelope for receiving and confining the rod, etc. In one aspect such an apparatus is disclosed in which the hook is movable with respect to the body member.
body member to vary the size of the capture envelope, both to initially facilitate emplacement of the apparatus about the rod, etc., and then to provide for tightening of the apparatus about the rod, etc., if desired.

**FIG. 9**

A welding torch for plasma arc welding apparatus has a transparent shield cup disposed about the constricting nozzle, the cup including a small outwardly extending polished lip. A guide tube extends externally of the torch and has a free end adjacent to the lip. First and second optical fiber bundle assemblies are supported within the guide tube. Light from a strobe light is transmitted along one of the assemblies to the free end and through the lip onto the weld site. A lens is positioned in the guide tube adjacent to the second assembly and focuses images of the weld site onto the end of the fiber bundle of the second assembly and these images are transmitted along the second assembly to a video camera so that the weld site may be viewed continuously for monitoring the welding process.
A system for coupling an orbital replacement unit (ORU) to a space station structure via the actions of a robot and/or astronaut is described. This system provides mechanical and electrical connections both between the ORU and the space station structure and between the ORU and the robot/astronaut hand tool. Alignment and timing features ensure safe, sure handling and precision coupling. This includes a first female type spline connector selectively located on the space station structure, a male type spline connector positioned on the orbital replacement unit so as to mate with and connect to the first female type spline connector, and a second female type spline connector located on the orbital replacement unit. A compliant drive rod interconnects the second female type spline connector and the male type spline connector. A robotic special end effector is used for mating with and driving the second female type spline connector. Also included are alignment tabs exteriorly located on the orbital replacement unit for berthing with the space station structure. The first and second female type spline connectors each include a threaded bolt member having a captured nut member located thereon which can translate up and down the bolt but are constrained from rotation thereabout, the nut member having a mounting surface with at least one first type electrical connector located on the mounting surface for translating with the nut member. At least one complementary second type electrical connector on the orbital replacement unit mates with at least one first type electrical connector on the mounting surface of the nut member. When the driver on the robotic end effector mates with the second female type spline connector and rotates, the male type spline connector and the first female type spline connector lock together, the driver and the second female type spline connector lock together, and the nut members translate up the threaded bolt members carrying the first type electrical connector up to the complementary second type connector for interconnection therewith.
The invention is a counter-balanced, multiple cable construction crane. The apparatus for hoisting payloads comprises a crane having a lifting means, the lifting means comprising an end effector means and three suspension means or cables. One end of each cable attaches to a different winding means located on the lifting means, and the other end of each cable attaches to a different point on the end effector, such that the three cables have a theoretical point of convergence with this point corresponding to the center of mass of the payload. Three controls command rotation of the winding means to a predetermined position. Accordingly, the crane provides precise and autonomous positioning of the payload without human guidance. The crane further comprises a counter-balancing means. Two controls position the counter-balancing means to offset the overturning moment which arises during the lifting of heavy payloads.

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Three lead screws are provided for adjusting the position of a traversing plate. Each of the three lead screws is threaded through a collar that is press fitted through the center of one of three pinion gears. A sun gear meshes with all three pinion gears and transversely moves the three lead screws upon actuation of a drive gear. The drive gear meshes with the sun gear and is driven by a handle or servomotor. When the handle or servomotor rotates the drive gear, the sun gear rotates causing the three pinion gears to rotate, thus, causing transverse movement of the three lead screws and, accordingly, transverse movement of the traversing plate. When the drive gear rotates, the traversing plate is driven in and out of a microwave cavity. Thus, the length or size of the cavity can be tuned while maintaining the traversing plate in an exact parallel relationship with an opposing plate on another end of the cavity.
N94-20380* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

TURNTABLE MECHANISM Patent

In vacuum plasma spraying a turntable must be provided which not only makes it possible to rotate and tilt a heavy workpiece, but to operate at vacuum plasma temperatures to do so. In the vacuum plasma coating of large parts such as combustion chambers of rocket engines, the workpiece must not only be rotated, but it must be tilted. Hence, the turntable must be capable not only of supporting heavy parts, but of angulating such heavy workpieces. And this must be done without drive means failure due to extremely high temperatures under which the turntable mechanism is operated. A turntable mechanism is provided which is capable of operating under such conditions. For cooling the turntable drive mechanism, internal cooling means are included.

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N94-20494*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

CLIMBING ROBOT Patent

A mobile robot for traversing any surface consisting of a number of interconnected segments, each interconnected segment having an upper 'U' frame member, a lower 'U' frame member, a compliant joint between the upper 'U' frame member and the lower 'U' frame member, a number of linear actuators between the two frame members acting to provide relative displacement between the frame members, a foot attached to the lower 'U' frame member for adherence of the segment to the surface, an inter-segment attachment member for providing the upper 'U' frame member for interconnecting the segments, a power source connected to the linear actuators, and a computer/controller for independently controlling each linear actuator in each interconnected segment such that the mobile robot moves in a caterpillar like fashion.

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

N94-20597* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

METHOD FOR REMOTELY POWERING A DEVICE SUCH AS A LUNAR ROVER Patent

A method of supplying power to a device such as a lunar rover located on a planetary surface is provided. At least one, and preferably, three, laser satellites are set in orbit around the planet. Each satellite contains a nuclear reactor for generating electrical power. This electrical power is converted into a laser beam which is passed through an amplifying array and directed toward the device such as a lunar rover. The received laser beam is then converted into electrical power for use by the device.

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N94-20589* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HIGH-TEMPERATURE, HIGH-PRESSURE OXYGEN METERING VALVE Patent

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

37 MECHANICAL ENGINEERING

N94-20589* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
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.

SPLINE SCREW MULTIPLE ROTATIONS MECHANISM Patent
JOHN M. VRANISH, inventor (to NASA) 21 Dec. 1993 10 p Filed 17 Sep. 1992

A system for coupling two bodies together and for transmitting torque from one body to another with mechanical timing and sequencing is reported. The mechanical timing and sequencing is handled so that the following criteria are met: (1) the bodies are handled in a safe manner and nothing floats loose in space, (2) electrical connectors are engaged as long as possible so that the internal processes can be monitored throughout by sensors, and (3) electrical and mechanical power and signals are coupled. The first body has a splined driver for providing the input torque. The second body has a threaded drive member capable of rotation and limited translation. The embedded drive member will mate with and fasten to the splined driver. The second body has an embedded bevel gear member capable of rotation and limited translation. This bevel gear member is coaxial with the threaded drive member. A compression spring provides a preload on the rotating threaded member, and a thrust bearing is used for limiting the translation of the bevel gear member so that when the bevel gear member reaches the upward limit of its translation the two bodies are fully coupled and the bevel gear member then rotates due to the input torque transmitted from the splined driver through the threaded drive member to the bevel gear member. An output bevel gear with an attached output drive shaft is embedded in the second body and meshes with the threaded rotating bevel gear member to transmit the input torque to the output drive shaft.

SPLIT SPLINE SCREW Patent
JOHN M. VRANISH, inventor (to NASA) 16 Nov. 1993 8 p Filed 27 Jul. 1992

A split spline screw type payload fastener assembly, including three identical male and female type split spline sections, is discussed. The male spline sections are formed on the head of a male type spline driver. Each of the split male type spline sections has an outwardly projecting load bearing segment including a convex upper surface which is adapted to engage a complementary concave surface of a female spline receptor in the form of a hollow bolt head. Additionally, the male spline section also includes a horizontal spline releasing segment and a spline tightening segment below each load bearing segment. The spline tightening segment consists of a vertical web of constant thickness. The web has at least one flat vertical wall surface which is designed to contact a generally flat vertically extending wall surface tab of the bolt head. Mutual interlocking and unlocking of the male and female splines results upon clockwise and counter clockwise turning of the driver element.
FINGERED BOLA BODY, BOLA WITH SAME, AND METHODS OF USE Patent

The present invention discloses bola bodies, bolas, and a snaring method which makes use such devices. A bola body, according to the present invention, is nonspherical or irregular in shape rather than a smooth sphere or ovoid body. One or more fingers extend from the bola body. These fingers may be relatively straight or they may have crooked or bent portions to enhance entanglement with a bola line or lines or with each other. Two or more of such fingers may be used and may be regularly or irregularly spaced apart on a bola body. A bola with such bodies includes lines which are connected to the other bodies. In one particular embodiment of a bola body, according to the present invention, the body has an irregular shape with a bottom rectangular portion and a top pyramid portion forming a nose. A plurality of fingers is extended from the pyramidal top portion with one finger extended up and away from each of four corners of the top portion. Such a bola body tends to be initially oriented with its nose and fingers against an object being snared since the body is pulled nose first when a bola line is secured at the tip of the pyramidal portion of the bola body. With such a bola, an unwrapping bola body can slip around a target member so that two of the rod-shaped fingers catch a bola line and guide it into an area or crook between the fingers and a side of the top pyramidal portion of the bola body. Tension on the bola line maintains the line in the crook and tends to press the fingers against the unwrapped target member to stabilize the wrapping of the line about the target member. With such a bola, it is difficult for two or more lines unwrapping in different directions to move past one another without being forced together by line tension. Also, the fingers of such bola bodies may hook and hold each other. The fingers may also hook or entangle some object on or portion of the target member. A probable known target member has known dimensions and shapes so that the bola may be sized and configured to reliably snare such a known target. The bolas can be optimally sized, fashioned, and configured to contact and hold a probable target of known size, dimension, and shape.

MAGNETIC POWER PISTON FLUID COMPRESSOR Patent

A compressor with no moving parts in the traditional sense having a housing having an inlet end allowing a low pressure fluid to enter and an outlet end allowing a high pressure fluid to exit is described. Within the compressor housing is at least one compression stage to increase the pressure of the fluid within the housing. The compression stage has a quantity of magnetic powder within the housing, is supported by a screen that allows passage of the fluid, and a coil for selectively providing a magnetic field across the magnetic powder such that when the magnetic field is not present the individual particles of the powder are separated allowing the fluid to flow through the powder and when the magnetic field is present the individual particles of the powder pack together causing the powder mass to expand preventing the fluid from flowing through the powder and causing a pressure pulse to compress the fluid.

ELECTROMAGNETIC BRAKE/CLUTCH DEVICE Patent

An electromagnetic brake/clutch device includes a drive shaft supported by at least one bearing for transmitting torque, a housing affixed to prevent its rotation, surrounding the drive shaft, and an electromagnetically activated device within the housing to selectively prevent and allow rotation of the drive shaft. The electromagnetically activated device includes a plurality of cammed rollers to...
prevent counter-clockwise rotation of the drive shaft. The drive shaft includes a circumferential disk and the housing includes a reaction ring for engagement with the plurality of cammed rollers. The plurality of cammed rollers are released from engagement with the circumferential disk and the reaction ring by a plurality of tripping mechanisms within the housing. The tripping action uses the locking force to act as a release force merely by changing the boundary conditions of the roller interface angles. The tripping mechanisms include trippers for disengaging the plurality of cammed rollers and an anvil shaped portion for providing lateral movement of the trippers. The plurality of cammed rollers is preloaded to engagement with the circumferential disk and reaction ring by a spring, and is located with respect to an adjacent tripping mechanism with another spring.

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The received signal is then digitized. The received signal is next sampled at four times its frequency based on a reference signal from the oscillator and then characterized as a phasor. The phase and amplitude of the received signal are then calculated via trigonometric relationship of at least two samples separated by 90 degrees. The remaining samples are employed to reduce the noise equivalent bandwidth.

NASA

A method of recertifying a load on a bearing member using a pulsed phase locked loop (P2L2) system is disclosed. A first tone burst signal with a corresponding first phase signal is generated in the bearing member in a first load condition. The sample/hold of the P2L2 is adjusted to a determined phase point on the first phase signal and then the P2L2 is locked at this phase period to determine a first load measurement. Next, the phase sample point is correlated with a corresponding position, w, on the first tone burst signal. A second tone burst with a corresponding second phase signal is then generated at some later time in the bearing member in a second load condition. The sample/hold of the P2L2 is adjusted to a determined phase point on the first phase signal and then the P2L2 is locked at this phase period to determine a first load measurement. Next, the phase sample point is correlated with a corresponding position, w, on the first tone burst signal. A second tone burst with a corresponding second phase signal is then generated at some later time in the bearing member in a second load condition. The sample/hold is adjusted to the sample/hold phase point as before and then the output frequency of the P2L2 is adjusted...
until the sample/hold is positioned at the previously determined phase point corresponding to position w on the second tone burst signal. The P2L2 is then locked at this phase point to determine a frequency indicative of the load of the second loading condition.

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

N94-20196 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SELF-DEPLOYING PHOTOVOLTAIC POWER SYSTEM Patent

A lightweight flexible photovoltaic (PV) blanket is attached to a support structure of initially stowed telescoping members. The deployment mechanism comprises a series of extendable and rotatable columns. As these columns are extended the PV blanket is deployed to its proper configuration.

N94-23308 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
METHOD OF DETERMINING SHEAR STRESS EMPLOYING A MONOMER-POLYMER LAMINATE STRUCTURE Patent

A laminate structure attached to the test surface of an article is presented. The laminate structure is comprised of a liquid crystal polymer substrate. A light absorbing coating is applied to the substrate and is thin enough to permit bonding steric interaction between the liquid crystal polymer substrate and an overlying liquid crystal monomer thin film. Light is directed through and reflected by the liquid crystal monomer thin film and unreflected light is absorbed by the underlying coating. The wavelength of the reflected light is indicative of the shear stress experienced by the test surface.

N94-15967 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
QUANTITATIVE METHOD OF MEASURING CANCER CELL UROKINASE AND METASTATIC POTENTIAL Patent
The metastatic potential of tumors can be evaluated by the quantitative detection of urokinase and DNA. The cell sample selected for examination is analyzed for the presence of high levels of urokinase and abnormal DNA using analytical flow cytometry and digital image analysis. Other factors such as membrane associated urokinase, increased DNA synthesis rates and certain receptors can be used in the method for detection of potentially invasive tumors.

Method and apparatus to characterize ultrasonically reflective contrast agents

A method and apparatus for characterizing the time and frequency response of an ultrasonically reflective contrast agent is disclosed. An ultrasonically reflective contrast agent is injected, under constant pressure, into a fluid flowing through a pump flow circuit. The fluid and the ultrasonically reflective contrast agent are uniformly mixed in a mixing chamber, and the uniform mixture is passed through a contrast agent chamber. The contrast agent chamber is acoustically and axially interposed between an ultrasonic transducer chamber and an acoustic isolation chamber. A pulse of ultrasonic energy is transmitted into the contrast agent chamber from the ultrasonic transducer chamber. An echo waveform is received from the ultrasonically reflective contrast agent, and it is analyzed to determine the time and frequency response of the ultrasonically reflective contrast agent.

Cultured normal mammalian tissue and process

Normal mammalian tissue and the culturing process has been developed for the three groups of organ, structural and blood tissue. The cells are grown in vitro under microgravity culture conditions and form three dimensional cell aggregates with normal cell function. The microgravity culture conditions may be microgravity or simulated microgravity created in a horizontal rotating wall culture vessel.

Extra-corporeal blood access, sensing, and radiation methods and apparatuses

The described invention is related to extra-corporeal blood access and radiation methods and apparatuses and, in particular, to subjecting flowing blood to energy in variety of forms, including radiation, electromagnetic force fields or atomic particles. It is
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

includes human engineering, biotechnology, and space suits and protective clothing.

N94-15883* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
INFLATABLE RESCUE DEVICE Patent Application
SCOTT A. SWAN, inventor (to NASA) 4 May 1993 21 p
(NASA-CASE-MSC-22244-1; NAS 1.71; MSC-22244-1; US-PATENT-APPL-SN-066274) Avail. CASI HC A03/MF A01
This invention discloses, in one aspect, a personal rescue device for use in outer space which has an inflatable flexible tube with a shaper apparatus herein. Gas under pressure flows through the shaper apparatus and into the flexible tube. The flexible tube is mounted to the shaper so that as it inflates it expands and deploys lengthwise away from the shaper. In one embodiment a housing contains the shaper and the flexible tube and the housing is designed to facilitate movement of the expanding tube from the housing so the expanding tube does not bunch up in the housing.

N94-20493* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATIC LOCKING ORTHOTIC KNEE DEVICE Patent
BRUCE C. WEDDENDORF, inventor (to NASA) 7 Dec. 1993 8 p
An articulated tang in clevis joint for incorporation in newly manufactured conventional strap-on orthotic knee devices or for replacing such joints in conventional strap-on orthotic knee devices is discussed. The instant tang in clevis joint allows the user the freedom to extend and bend the knee normally when no load (weight) is applied to the knee and to automatically lock the knee when the user transfers weight to the knee, thus preventing a damaged knee from bending uncontrollably when weight is applied to the knee. The tang in clevis joint of the present invention includes first and second clevis plates, a tang assembly and a spacer plate secured between the clevis plates. Each clevis plate includes a
bevelled serrated upper section. A bevelled shoe is secured to the
tank in close proximity to the bevelled serrated upper section of the
clevis plates. A coiled spring mounted within an oblong bore of the
tang normally urges the shoes secured to the tang out of engage-
ment with the serrated upper section of each clevis plate to allow
rotation of the tang relative to the clevis plate. When weight is
applied to the joint, the load compresses the coiled spring, the
serrations on each clevis plate dig into the bevelled shoes secured
to the tang to prevent relative movement between the tang and
clevis plates. A shoulder is provided on the tang and the spacer
plate to prevent overextension of the joint.

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61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms, and specific
applications, e.g., CAD/CAM.

N94-15703** National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, MD.
LINEAR ENCODING DEVICE Patent Application
DOUGLAS B. LEVITON, inventor (to NASA) 29 Mar. 1993 22 p
(NASA-CASE-GSC-13562-1; NAS 1.71:GSC-13562-1; US-
PATENT-APPL-SN-037876) Avail: CASI HC A03/MF A01

A Linear Motion Encoding device for measuring the linear
motion of a moving object is disclosed in which a light source is
mounted on the moving object and a position sensitive detector such
as an array photodetector is mounted on a nearby stationary object.
The light source emits a light beam directed towards the array
photodetector such that a light spot is created on the array.
An analog-to-digital converter, connected to the array photodetector is
used for reading the position of the spot on the array photodetector.
A microprocessor and memory is connected to the analog-to-digital
converter to hold and manipulate data provided by the
analog-to-digital converter on the position of the spot and to compute the linear displacement of the moving object
based upon the data from the analog-to-digital converter.

N94-17326** National Aeronautics and Space Administration.
Pasadena Office, CA.
METHOD AND APPARATUS FOR SPUR-REDUCED DIGITAL
SINUSOID SYNTHESIS Patent Application
GEORGE A. ZIMMERMAN, inventor (to NASA) (Jet Propulsion
Lab., California Inst. of Tech., Pasadena.) and MICHAEL J.
FLANAGAN, inventor (to NASA) (Jet Propulsion Lab., California
Inst. of Tech., Pasadena.) 20 Oct. 1993 56 p
(Contract NAS7-918)
(NASA-CASE-NPO-18789-1-CU; NAS 1.71:NPO-18789-1-CU;

A technique for reducing the spurious signal content in digital
sinusoid synthesis is presented. Spur reduction is accomplished
through dithering both amplitudes and phase values prior to
word-length reduction. The analytical approach developed for ana-
log quantization is used to produce new bounds on spur performance
in these dithered systems. Amplitude dithering allows output
word-length reduction without introducing additional spurs. Effects
of periodic dither similar to that produced by a pseudo-noise (PN)
generator are analyzed. This phase dithering method provides a
spur reduction of 6(M + 1) dB per phase bit when the dither consists
of M uniform variates. While the spur reduction is at the expense of an increase in system noise, the noise power can be made white, making the power spectral density small. This technique permits the use of a smaller number of phase bits addressing sinusoid look-up tables, resulting in an exponential decrease in system complexity. Amplitude dithering allows the use of less complicated multipliers and narrower data paths in purely digital applications, as well as the use of coarse-resolution, highly-linear digital-to-analog converters (DACs) to obtain spur performance limited by the DAC linearity rather than its resolution.

N94-20492# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. RECONFIGURABLE FUZZY CELL Patent
This invention relates to a reconfigurable fuzzy cell comprising a digital control programmable gain operation amplifier, an analog-to-digital converter, an electrically erasable PROM, and an 8-bit counter and comparator, and supporting logic configured to achieve in real-time fuzzy systems high throughput, grade-of-membership or membership-value conversion of multi-input sensor data. The invention provides a flexible multiplexing-capable configuration, implemented entirely in hardware, for effectuating S-, Z-, and PI-membership functions or combinations thereof, based upon fuzzy logic level-set theory. A membership value table storing 'knowledge data' for each of S-, Z-, and PI-functions is contained within a nonvolatile memory for storing bits of membership and parametric information in a plurality of address spaces. Based upon parametric and control signals, analog sensor data is digitized and converted into grade-of-membership data. In situ learn and recognition modes of operation are also provided.

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The invention in one embodiment is a communication network including plural non-blocking crossbar nodes, first apparatus for connecting the nodes in a first layer of connecting links, and second apparatus for connecting the nodes in a second layer of connecting links independent of the first layer, whereby each layer is connected to the other layer at each one of the nodes. Preferably, each one of the layers of connecting links corresponds to one recirculating network topology that closes in on itself.

FIG. 2

63 CYBERNETICS

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


A capacitive type proximity sensor comprised of a capacitance type sensor, a capacitance type reference, and two independent and mutually opposing driven shields respectively adjacent to the sensor and reference and which are coupled in an electrical bridge circuit configuration and driven by a single frequency crystal controlled oscillator is presented. The bridge circuit additionally includes a pair of fixed electrical impedance elements which form adjacent arms of the bridge and which comprise either a pair of

electrode of a sensor capacitor, the other electrode is the object. The outer conductor is a thin sheet of conductive material with a pair (or more) of intermediate electrical conductors located between the outer conductor and the machine. The pair of intermediate electrical conductors are in close proximity to each other and together form a surface having a size substantially larger than the outer conductor to act as a shield for reducing the parasitic capacitance between the outer conductor and the machine and to steer the sensor field. The pair of intermediate conductors are thin sheets of conductive material substantially wider than the first conductor. The outer and pair of intermediate conductors are attached to a surface on the machine in electrical isolation and with no gaps between the conductors and no gap between the surface and the pair of intermediate conductors. The outer and pair of intermediate conductors are also in conformance with each other and the surface of the machine, and the surface of the machine acts as a ground plane. Variable gain voltage follower circuits are used for coupling, in phase, the instantaneous voltage at the outer electrical conductor to the pair of intermediate electrical conductors and a signal generator is coupled to the outer conductor and is responsive to the capacitance of the sensor capacitor for generating a control signal to the machine.


A capacitive type proximity sensor comprised of a capacitance type sensor, a capacitance type reference, and two independent and mutually opposing driven shields respectively adjacent to the sensor and reference and which are coupled in an electrical bridge circuit configuration and driven by a single frequency crystal controlled oscillator is presented. The bridge circuit additionally includes a pair of fixed electrical impedance elements which form adjacent arms of the bridge and which comprise either a pair of
precision resistances or capacitors. Detection of bridge unbalance provides an indication of the mutual proximity between an object and the sensor. Drift compensation is also utilized to improve performance and thus increase sensor range and sensitivity.

**FIG 2**

**FIG 5**

N94-15958** National Aeronautics and Space Administration, Pasadena Office, CA.

UNIPOLAR TERMINAL-ATTRACTOR BASED NEURAL ASSOCIATIVE MEMORY WITH ADAPTIVE THRESHOLD Patent Application


N94-20360** National Aeronautics and Space Administration. Pasadena Office, CA.

ELECTRONIC NEURAL NETWORK FOR SOLVING TRAVELING SALESMAN AND SIMILAR GLOBAL OPTIMIZATION PROBLEMS Patent


N94-20366** National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

NEURAL NETWORK FOR PROCESSING BOTH SPATIAL AND TEMPORAL DATA WITH TIME BASED BACK-PROPAGATION Patent


Neural networks are computing systems modeled after the paradigm of the biological brain. For years, researchers using various forms of neural networks have attempted to model the brain's information processing and decision-making capabilities. Neural network algorithms have impressively demonstrated the capability of modeling spatial information. On the other hand, the
application of parallel distributed models to the processing of temporal data has been severely restricted. The invention introduces a novel technique which adds the dimension of time to the well known back-propagation neural network algorithm. In the space-time neural network disclosed herein, the synaptic weights between two artificial neurons (processing elements) are replaced with an adaptable-adjustable filter. Instead of a single synaptic weight, the invention provides a plurality of weights representing not only association, but also temporal dependencies. In this case, the synaptic weights are the coefficients to the adaptable digital filters. Novelty is believed to lie in the disclosure of a processing element and a network of the processing elements which are capable of processing temporal as well as spacial data.

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**71 ACOUSTICS**

Includes sound generation, transmission, and attenuation.

**72 ATOMIC AND MOLECULAR PHYSICS**

Includes atomic structure, electron properties, and molecular spectra.

**N94-23312** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**HEAD RELATED TRANSFER FUNCTION PSEUDO-STEREOPHONY Patent**

DURAND R. BEGAULT, inventor (to NASA) 22 Dec. 1992 10 p

Filed 29 Jan. 1992


An apparatus for producing pseudo-stereophonic sound from a monaural signal is discussed. The apparatus includes a monaural source that has a speaker placed in an anechoic room and has a sound output generated by the monaural signal. The second, third, fourth, and fifth speakers are placed in the anechoic room symmetrically about a listener. The monaural signal from the source is processed to output processed signals to each of the second, third, fourth, and fifth speakers, each speaker producing a sound output corresponding to the received processed signal. A pair of microphones is placed in the ears of the listener for receiving the sound outputs of the first, second, third, fourth, and fifth speakers and producing two differentiated audio channels.

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**72 ATOMIC AND MOLECULAR PHYSICS**

Includes atomic structure, electron properties, and molecular spectra.

**N94-17329** National Aeronautics and Space Administration. Pasadena Office, CA.

**ELECTRON REVERSAL IONIZER FOR DETECTION OF TRACE SPECIES USING A SPHERICAL CATHODE Patent Application**


(Contract NAS7-918)

Avail: CASI HC A03/MF A01

A reversal electron, high-current ionizer capable of focusing a beam of electrons to a reversal region employs an indirectly heated cathode having a concave emitting surface of width of W less than 2r, where r is the radius of curvature and preferably a ratio of width to radius approximately equal to one for optimum high current for a given cathode width.

NASA
ATOMIC AND MOLECULAR PHYSICS

METHOD AND APPARATUS FOR PRODUCING A THERMAL ATOMIC OXYGEN BEAM Patent

Atomic oxygen atoms are routed to a material through a sufficiently tortuous path so that vacuum ultraviolet radiation is obstructed from arriving at the surface of the material. However, the material surface continues to be exposed to the atomic oxygen.

OPTICS

ALKALI METAL FOR ULTRAVIOLET BAND-PASS FILTER Patent

An acousto-optic tunable filter (AOTF) is employed to generate a display by driving the AOTF with a RF electrical signal comprising modulated red, green, and blue video scan line signals and scanning the AOTF with a linearly polarized, pulsed light beam, resulting in encoding of color video columns (scan lines) of an input video image into vertical columns of the AOTF output beam. The AOTF is illuminated periodically as each acoustically-encoded scan line fills the cell aperture of the AOTF. A polarizing beam splitter removes the unused first order beam component of the AOTF output and, if desired, overlays a real world scene on the output plane. Resolutions as high as 30,000 lines are possible, providing holographic display capability.
A device for position encoding of a rotating shaft in which a polygonal mirror having a number of facets is mounted to the shaft and a monochromatic light beam is directed towards the facets. The facets of the polygonal mirror each have a low line density diffraction grating to diffract the monochromatic light beam into a number of diffracted light beams such that a number of light spots are created on a linear array detector. An analog-to-digital converter is connected to the linear array detector for reading the position of the spots on the linear array detector means. A microprocessor with memory is connected to the analog-to-digital converter to hold and manipulate the data provided by the analog-to-digital converter on the position of the spots and to compute the position of the shaft based upon the data from the analog-to-digital converter.

The sensitivity model of a complex optical system obtained by linear ray tracing is used to compute a control gain matrix by imposing the mathematical condition for minimizing the total wavefront error at the optical system's exit pupil. The most recent deformations or error states of the controlled segments or optical surfaces of the system are then assembled as an error vector, and the error vector is transformed by the control gain matrix to produce the exact control variables which will minimize the total wavefront error at the exit pupil of the optical system. These exact control variables are then applied to the actuators controlling the various optical surfaces in the system causing the immediate reduction in total wavefront error observed at the exit pupil of the optical system.
WIDE-ANGLE IMAGING SYSTEM WITH FIBEROPTIC COMPONENTS PROVIDING ANGLE-DEPENDENT VIRTUAL MATERIAL STOPS Patent

A strip imaging wide angle optical system is provided. The optical system is provided with a 'virtual' material stop to avoid aberrational effects inherent in wide angle optical systems. The optical system includes a spherical mirror section for receiving light from a 180 deg strip or arc of a target image. Light received by the spherical mirror section is reflected to a frustoconical mirror section for subsequent rereflection to a row of optical fibers. Each optical fiber transmits a portion of the received light to a detector. The optical system exploits the narrow cone of acceptance associated with optical fibers to substantially eliminate vignetting effects inherent in wide angle systems. Further, the optical system exploits the narrow cone of acceptance of the optical fibers to substantially limit spherical aberration. The optical system is ideally suited for any application wherein a 180 deg strip image need be detected, and is particularly well adapted for use in hostile environments such as in planetary exploration.

Optical fibers may have applications including fluorosensors which sense the concentration of an analyte. Like communication fibers, these fluorosensors are modeled using a weakly guiding approximation which is only effective when the difference between the respective refractive indices of the fiber core and surrounding cladding are minimal. An optical fiber fluorosensor is provided having a portion of a fiber core which is surrounded by an active cladding which is permeable by the analyte to be sensed and containing substances which emit light waves upon excitation. A remaining portion of the fiber core is surrounded by a guide cladding which guides these light waves to a sensor which detects the intensity of waves, which is a function of the analyte concentration. Contrary to conventional weakly guiding principles, the difference between the respective indices of refraction of the fiber core is surrounded by an active cladding which is thin enough such that its index of refraction is effectively that of the surrounding atmosphere, thereby the atmosphere guides the injective indices of the fiber core and the cladding results in an unexpected increase in the power efficiency of the fiber core.
PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

N94-20491* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

METHOD FOR ANISOTROPIC ETCHING IN THE MANUFACTURE OF SEMICONDUCTOR DEVICES Patent

STEVEN L. KOONTZ, inventor (to NASA) and JON B. CROSS, inventor (to NASA) 21 Dec. 1993 11 p Filed 12 Jul. 1991
Hydrocarbon polymer coatings used in microelectronic manufacturing processes are anisotropically etched by hyperthermal atomic oxygen beams (translational energies of 0.2 to 20 eV, preferably 1 to 10 eV). Etching with hyperthermal oxygen atom species obtains highly anisotropic etching with sharp boundaries between etched and mask protected areas.

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Lattices of alternating layers of monocrystalline silicon and porous silicon-germanium have been produced. These single crystal lattices have been fabricated by epitaxial growth of Si and Si-Ge layers followed by patterning into mesa structures. The mesa structures are stain etched resulting in porosification of the Si-Ge layers with a minor amount of porosification of the monocrystalline Si layers. Thicker Si-Ge layers produced in a similar manner emitted visible light at room temperature.

NASA
ASTRONOMY

N94-20528* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

METHOD FOR CONTROLLING PROTEIN CRYSTALLIZATION Patent

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 desiccant within the receptacle.

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N94-23972* National Aeronautics and Space Administration. Pasadena Office, CA.

METHOD OF FORMING SILICON STRUCTURES WITH SELECTABLE OPTICAL CHARACTERISTICS Patent

The design and performance of a wide angle, single screen, frequency selective surface (FSS) with gridded square-loop path elements are described for diplexing closely separated signal bands, for example, X- and Ku-band signals in an Orbiting Very Long Baseline Interferometer (OVLBI) earth station reflector antenna system, as well as other applications such as military and commercial communications via satellites. Excellent agreement is obtained between the predicted: and measured results of this FSS design using the gridded square-loop patch elements sandwiched between 0.0889 cm thick tetrafluoroethylene fluorocarbon polymer (PTFE) slabs. Resonant frequency drift is reduced by 1 GHz with an incident angle from 0 degrees normal to 40 degrees from normal.

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N94-23972 National Aeronautics and Space Administration. Pasadena Office, CA.

METHOD OF FORMING SILICON STRUCTURES WITH SELECTABLE OPTICAL CHARACTERISTICS Patent

The design and performance of a wide angle, single screen, frequency selective surface (FSS) with gridded square-loop path elements are described for diplexing closely separated signal bands, for example, X- and Ku-band signals in an Orbiting Very Long Baseline Interferometer (OVLBI) earth station reflector antenna system, as well as other applications such as military and commercial communications via satellites. Excellent agreement is obtained between the predicted: and measured results of this FSS design using the gridded square-loop patch elements sandwiched between 0.0889 cm thick tetrafluoroethylene fluorocarbon polymer (PTFE) slabs. Resonant frequency drift is reduced by 1 GHz with an incident angle from 0 degrees normal to 40 degrees from normal.

N94-17438* National Aeronautics and Space Administration. Pasadena Office, CA.

WIDE ANGLE, SINGLE SCREEN, GRIDDED SQUARE-LOOP FREQUENCY SELECTIVE SURFACE FOR DIPLEXING TWO CLOSELY SEPARATED FREQUENCY BANDS Patent Application
(Contract NAS7-918)

The design and performance of a wide angle, single screen, frequency selective surface (FSS) with gridded square-loop path elements are described for diplexing closely separated signal bands, for example, X- and Ku-band signals in an Orbiting Very Long Baseline Interferometer (OVLBI) earth station reflector antenna system, as well as other applications such as military and commercial communications via satellites. Excellent agreement is obtained between the predicted: and measured results of this FSS design using the gridded square-loop patch elements sandwiched between 0.0889 cm thick tetrafluoroethylene fluorocarbon polymer (PTFE) slabs. Resonant frequency drift is reduced by 1 GHz with an incident angle from 0 degrees normal to 40 degrees from normal.

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89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy; and astrometry.
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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.
PATENT LICENSING REGULATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
14 CFR Part 1245
Patents and Other Intellectual Property Rights
AGENCY: National Aeronautics and Space Administration (NASA).

ACTION: Final Rule.

SUMMARY: 14 CFR part 1245, subpart 2, "Licensing of NASA Inventions" provides policies and procedures applicable to the licensing of federally owned inventions in the custody of the National Aeronautics and Space Administration and implements Public Law 96-517. The object of subpart 2 is to use the patent system to promote the utilization of inventions arising from NASA supported research and development.

EFFECTIVE DATE: December 13, 1990.


FOR FURTHER INFORMATION CONTACT: Harry Lupuloff, (202) 358-2041

SUPPLEMENTARY INFORMATION:
14 CFR part 1245, subpart 2 is amended by revising NASA position titles in §1245.208(a), (b), and (c). Since this action is internal and administrative in nature and does not affect the existing regulations, notice and public comment are not required.

The National Aeronautics and Space Administration has determined that:
(1) This rule is not subject to the requirements of the Regulatory Flexibility Act, 5 U.S.C. 601-612, since it will not exert a significant impact on a substantial number of small business entities.
(2) This rule is not a major rule as defined in Executive Order 12291.
List of Subjects in 14 CFR part 1245
Administrative practice and procedure. Authority delegations (Government agencies). Inventions and patents.

For reasons set out in the Preamble, 14 CFR part 1245 is amended as follows:

PART 1245—PATENTS AND OTHER INTELLECTUAL PROPERTY RIGHTS

§1245.200 Scope of subpart.
This subpart prescribes the terms, conditions and procedures upon which a NASA invention may be licensed. It does not affect licenses which (a) were in effect prior to July 1, 1981; (b) may exist at the time of the Government's acquisition of title to the invention, including those resulting from the allocation of rights to inventions made under Government research and development contracts; (c) are the result of an authorized exchange of rights in the settlement of patent disputes; or (d) are otherwise authorized by law or treaty.

§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) "Federally owned invention" means an invention, plant, or design which is covered by a patent, or patent application in the United States, or a patent, patent application, plant variety protection, or other form of protection, in a foreign country, title to which has been assigned to or otherwise vested in the United States Government.
(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 2 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, to practice in the case of a process or method, or to operate in the case of a machine or system, and, in each case, under such conditions, 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.

Types of Licenses

1245.205 Nonexclusive licenses.
1245.206 Exclusive and partially exclusive licenses.

Procedures

1245.207 Application for a license.
1245.208 Processing applications.
1245.209 Notice to Attorney General.
1245.210 Modification and termination of licenses.
1245.211 Appeals.
1245.212 Protection and administration of inventions.
1245.213 Transfer of custody.
1245.214 Confidentiality of information.

PATENT LICENSING REGULATIONS

(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.

(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;

(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:

(1) 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;

(2) 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;

(3) 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

(4) 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 any licenses in force at the time of the grant of the exclusive or partially exclusive license.

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

(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 be modified or terminated, consistent with this subpart, upon mutual agreement of NASA and the licensee.

(3) The licensee shall make reference to the license, including the rights retained by the Government, and a copy of such license shall be furnished to NASA.

(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 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 foreign exclusive and partially exclusive licenses:

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

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

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

(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 regarding manufacturing, marketing, financial, and technical resources;

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

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

(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 Associate General Counsel (Intellectual Property). 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 Associate General Counsel (Intellectual Property) 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)(iii)(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 Associate General Counsel (Intellectual Property).

(c) If the requested license, including any negotiated modifications, is denied by the Associate General Counsel (Intellectual Property), 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.

Dated: November 23, 1990

Richard H. Truly,
Administrator.

BILLING CODE 7510-01-M

§1245.209 Notice to Attorney General.

A copy of the notice provided for in §§1245.206(a)(1)(iii)(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:

(1) A person whose application for a license has been denied;

(2) A licensee whose license has been modified or terminated, in whole or in part; or

(3) A person who timely filed a written objection in response to the notice required by §§1245.206(a)(1)(iii)(A) or 1245.206(b)(1)(i) and who can demonstrate to the satisfaction of NASA that such person may be damaged by the Agency action.

(b) Written notice of appeal must be filed within 30 days (or such other time as may be authorized for good cause shown) after receiving notice of the adverse decision or determination; including, an adverse decision following the request for reconsideration under §1245.208(c). The notice of appeal, along with all supporting documentation should be addressed to the Administrator, National Aeronautics and Space Administration, Washington, DC 20546. Should the appeal raise a genuine dispute over material facts, fact-finding will be conducted by the NASA Inventions and Contributions Board. The person filing the appeal shall be afforded an opportunity to be heard and to offer evidence in support of the appeal. The Chairperson of the Inventions and Contributions Board shall prepare written findings of fact and transmit them to the Administrator or designee. The decision on the appeal shall be made by the NASA Administrator or designee. There is no further right of administrative appeal from the decision of the Administrator or designee.

§1245.212 Protection and administration of inventions.

NASA may take any suitable and necessary steps to protect and administer rights to NASA inventions, either directly or through contract.

§1245.213 Transfer of custody.

NASA having custody of certain Federally owned inventions may transfer custody and administration in whole or in part, to another Federal agency, of the right, title, or interest in any such invention.

§1245.214 Confidentiality of information.

Title 35, United States Code, section 209, provides that any plan submitted pursuant to §1245.207(h) and any report required by §1245.204(b)(6) may be treated by NASA as commercial and financial information obtained from a person and privileged and confidential and not subject to disclosure under section 552 of Title 5 of the United States Code.

James M. Beggs,
Administrator.

October 15, 1981.

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Abstracts are provided for 137 patents and patent applications entered into the NASA scientific and technical information system during the period January 1994 through June 1994. 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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