Section 1 • Abstracts

JUNE 1990
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This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.
Annotated references to NASA-owned inventions covered by U.S. patents and applications for patent that were announced in Scientific and Technical Aerospace Reports (STAR) between January 1990 and June 1990.
This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, price code A03.
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 76 citations published in this issue of the Abstract Section cover the period January 1990 through June 1990. The Index Section references over 4600 citations covering the period May 1969 through June 1990.

ABSTRACT SECTION (SECTION 1)

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

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

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

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

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

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

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

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

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

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

HOW TO USE THIS PUBLICATION TO IDENTIFY NASA INVENTIONS

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

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

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

(3) Using Patent Classification Index: To identify all inventions covered by issued NASA patents (not including applications for patent) within a desired Patent Classification, (A) turn to the Patent Classification Number in the Number Index of Section 2 and find the associated invention(s), and (B) follow the instructions outlined in (2)(B), and (D) above.
An infrared photodetector is formed of a heavily doped p-type Ge(x)Si(1-x)/Si superlattice in which x is pre-established during manufacture in the range 0 to 100 percent. A custom tailored photodetector that can differentiate among close wavelengths in the range of 2.7 to 50 microns is fabricated by appropriate selection of the alloy constituency value, x, to establish a specific wavelength at which photodetection cut-off will occur.

Official Gazette of the U.S. Patent and Trademark Office
# TABLE OF CONTENTS

## Section 1. Abstracts

### AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

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  1
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  1
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)  2
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

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also Aeronautics.

#### 12 ASTRONAUTICS (GENERAL)  N.A.
For extraterrestrial exploration see 91 Lunar and Planetary Exploration.

#### 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  2
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.
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.
   For life support systems see 54 Man/System Technology and Life Support. For related information see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation.

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

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

CHEMISTRY AND MATERIALS
Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL)

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

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

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

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

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

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

ENGINEERING
   Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.
   For related information see also Physics.

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

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

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

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

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

36 LASERS AND MASERS
   Includes parametric amplifiers.
   For related information see also 76 Solid-State Physics.

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

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

39 STRUCTURAL MECHANICS
   Includes structural element design and weight analysis; fatigue; and thermal stress.
GEOSCIENCES
Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.
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 N.A.
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.

LIFE SCIENCES
Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.
51 LIFE SCIENCES (GENERAL) 20
52 AEROSPACE MEDICINE 21
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 N.A.
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
Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.
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 21
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.
62 COMPUTER SYSTEMS 22
Includes computer networks and special application computer systems.
63 CYBERNETICS N.A.
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 N.A.
Includes iteration, difference equations, and numerical approximation.
65 STATISTICS AND PROBABILITY N.A.
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.
66 SYSTEMS ANALYSIS N.A.
Includes mathematical modeling; network analysis; and operations research.
67 THEORETICAL MATHEMATICS N.A.
Includes topology and number theory.

PHYSICS
Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.
For related information see also Engineering.
70 PHYSICS (GENERAL) 23
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  N.A.  
   Includes atomic structure, electron properties, and molecular spectra.

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

74 OPTICS  24  
   Includes light phenomena and optical devices.
   For lasers see 36 Lasers and Masers.

75 PLASMA PHYSICS  25  
   Includes magnetohydrodynamics and plasma fusion.
   For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.

76 SOLID-STATE PHYSICS  26  
   Includes superconductivity.
   For related information see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

77 THERMODYNAMICS AND STATISTICAL PHYSICS  N.A.  
   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  
   Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL)  N.A.  
   Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT  N.A.  
   Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE  N.A.  
   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  N.A.  
   Includes cost effectiveness studies.

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

85 URBAN TECHNOLOGY AND TRANSPORTATION  N.A.  
   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  
   Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
   For related information see also Geosciences.

88 SPACE SCIENCES (GENERAL)  N.A.

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

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

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

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

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

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

99 GENERAL  N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

Section 2 - Indexes

SUBJECT INDEX  
INVENTOR INDEX  
SOURCE INDEX  

CONTRACT NUMBER INDEX  
NUMBER INDEX  
ACCESSION NUMBER INDEX
In a system for deriving position, velocity, and acceleration information from a received signal emitted from an object to be tracked wherein the signal comprises a carrier signal phase modulated by unknown binary data and experiencing very high Doppler and Doppler rate, this invention provides combined estimation/detection apparatus for simultaneously detecting data bits and obtaining estimates of signal parameters such as carrier phase and frequency related to receiver dynamics in a sequential manner. There is a first stage for obtaining estimates of the signal parameters related to phase and frequency in the vicinity of possible data transitions on the basis of measurements obtained within a current data bit. A second stage uses the estimates from the first stage to decide whether or not a data transition has actually occurred. There is a third stage for removing data modulation from the received signal when a data transition has occurred and a fourth stage for using the received signal with data modulation removed therefrom to update global parameters which are dependent only upon receiver dynamics and independent of data modulation. Finally, there is a fifth stage for using the global parameters to determine the position, velocity, and acceleration of the object.

FIG. 1
(PRIOR ART)

FIG. 2
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.

N90-16771# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HIGH-PRESSURE PROMOTED COMBUSTION CHAMBER Patent Application
MICHELLE A. RUCKER, inventor (to NASA) and JOEL M. STOLTZFUS, inventor (to NASA) 18 Jul. 1989 19 p
(NASA-CASE-MSC-21470-1; US-PATENT-APPL-SN-381239; NAS 1.71:MSC-21470-1) Avail: NTIS HC A03/MF A01 CSCL 148

In the preferred embodiment of the promoted combustion chamber disclosed herein, a thick-walled tubular body that is capable of withstanding extreme pressures is arranged with removable upper and lower end closures to provide access to the chamber for dependently supporting a test sample of a material being evaluated in the chamber. To facilitate the real-time analysis of a test sample, several pressure-tight viewing ports capable of withstanding the simulated environmental conditions are arranged in the walls of the tubular body for observing the test sample during the course of the test. A replaceable heat-resistant tubular member and replaceable flame-resistant internal liners are arranged to be fitted inside of the chamber for protecting the interior wall surfaces of the combustion chamber during the evaluation tests. Inlet and outlet ports are provided for admitting high-pressure gases into the chamber as needed for performing dynamic analyses of the test sample during the course of an evaluation test.

N90-16781# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A TWO-STAGE EARTH-TO-ORBIT TRANSPORT WITH TRANSLATING OBLIQUE WINGS FOR BOOSTER RECOVERY Patent Application
IAN O. MACCONOCHIE, inventor (to NASA) and CHARLES A. BREINER, inventor (to NASA) (PRC Kentron, Inc., Hampton, VA.) 9 Nov. 1989 13 p Sponsored by NASA

A two-stage earth-to-orbit transport is disclosed which includes an orbiter vehicle and a pair of boosters, each having a deployable oblique wing located along a longitudinal axis of the booster. The wing is deployed in an oblique disposition in supersonic and hypersonic speeds, and disposed at 90 degree for subsonic speeds encountered during entry. The oblique wing is driven axially and rotated by means of a turret mounted on rails.

N90-11798# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

DOCKING SYSTEM FOR SPACECRAFT Patent Application
JON B. KAHN, inventor (to NASA) 30 Dec. 1988 21 p

A mechanism is disclosed for the docking of a spacecraft to a space station where a connection for transfer of personnel and equipment is desired. The invention comprises an active docking system.
structure on a spacecraft and a passive docking structure on the station. The passive structure includes a docking ring mounted on a tunnel structure fixed to the space station. The active structure includes a docking ring carried by an actuator-attenuator devices, each attached at one end to the ring and at its other end in the spacecraft payload bay. The devices respond to command signals for moving the docking ring between a stowed position in the spacecraft to a deployed position suitable for engagement with the docking ring. The devices comprise means responsive to signals of sensed loadings to absorb impact energy and retraction means for drawing the coupled spacecraft and station into final docked configuration and moving the tunnel structure to a berthed position in the spacecraft. Latches couple the spacecraft and space station upon contact of the docking rings and latches establish a structural tie between the spacecraft when retracted.

NASA

N90-19278* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HATCH COVER Patent
CHARLES S. ALLTON, inventor (to NASA) and JAMES H. OKANE, inventor (to NASA) 27 Jun. 1989 8 p Filed 9 Mar. 1988

This invention relates to a hatch and more particularly to a hatch for a space vehicle where the hatch has a low volume sweep and can be easily manipulated from either side of the hatch. The hatch system includes an elliptical opening in a bulkhead and an elliptical hatch member. The hatch cover system includes an elliptical port opening in a housing and an elliptical cover member supported centrally by a rotational bearing for rotation about a rotational axis normal to the cover member and by pivot pins in a gimbal member for pivotal movement about axes perpendicular to the rotational axis. Arm members support the gimbal member pivotally by pivot members so that upon rotation and manipulation the cover member can be articulately moved from a closed position to the port opening to an out of the way position with a minimum of volume sweep by the cover member.

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SUITPORT EXTRA-VEHICULAR ACCESS FACILITY Patent

In a system for entering and leaving a space station, a bulkhead divides the module into an antechamber and an airlock. A space suit has a portable life support system (PLSS) interface on its back. The suit is removably attached to the bulkhead by the interface at a hatch in the bulkhead. A PLSS is detachably mounted in the hatch cover, which is pivotally mounted to move away from the hatch to allow an astronaut to enter the suit through the open hatch and the PLSS interface. After entering the suit, the astronaut closes the hatch and attaches the PLSS to the suit by the operating control to which the glove portion of the suit is attached. The astronaut initiates pumpdown of the airlock with the control. When the pumpdown is complete, the astronaut opens the hatch, disconnects the PLSS from the hatch cover, pivots the pressure vessels of the control to one side on their supports, disconnects
19 SPACECRAFT INSTRUMENTATION

SPACECRAFT INSTRUMENTATION

N90-10132*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

METHOD AND APPARATUS FOR DETERMINING TIME, DIRECTION AND COMPOSITION OF IMPACTING SPACE PARTICLES Patent Application
WILLIAM H. KINARD, inventor (to NASA); JIM J. WORTMAN, inventor (to NASA); PHILIP C. KASSEL, JR., inventor (to NASA); FRED S. SINGER, inventor (to NASA); DONALD H. HUMES, inventor (to NASA); and JOHN E. STANLEY, inventor (to NASA) (Virginia Univ., Charlottesville.) 21 Jun. 1989 19 p

A space particle collector for recording the time specific particles are captured, and its direction at the time of capture, utilizes an array of targets, each comprised of an MOS capacitor on a chip charges from an external source and discharged upon impact by a particle through a tab on the chip that serves as a fuse. Any impacting particle creates a crater, but only the first will cause a discharge of the capacitor. A substantial part of the metal film around the first crater is burned off by the discharge current. The time of the impulse which burns the tab, and the identification of the target, is recorded together with data from flight instruments. The metal film is partitioned into pie sections to provide a plurality of targets on each of an array of silicon wafers, thus increasing the total number of identified particles that can be collected. It is thus certain which particles were captured at what specific times.

NASA

N90-15130*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EXTENDED TEMPERATURE RANGE ROCKET INJECTOR Patent Application
STEVEN J. SCHNEIDER, inventor (to NASA) 30 Nov. 1989 9 p

A rocket injector is provided with multiple sets of manifolds for supplying propellants to injector elements. Sensors transmit the temperatures of the propellants to a suitable controller which is operably connected to valves between these manifolds and propellant storage tanks. When cryogenic propellant temperatures are sensed only a portion of the valves are opened to furnish propellants to some of the manifolds. When lower temperatures are sensed additional valves are opened to furnish propellants to more of the manifolds.

NASA

DUAL-FUEL, DUAL-MODE ROCKET ENGINE Patent
JAMES A. MARTIN, inventor (to NASA) 23 May 1989 9 p
Filed 9 Mar. 1988

The invention relates to a dual fuel, dual mode rocket engine designed to improve the performance of earth-to-orbit vehicles. For any vehicle that operates from the earth's surface to earth orbit, it is advantageous to use two different fuels during its ascent. A high density impulse fuel, such as kerosene, is most efficient during the first half of the trajectory. A high specific impulse fuel, such as hydrogen, is most efficient during the second half of the trajectory. The invention allows both fuels to be used with a single rocket engine. It does so by adding a minimum number of state-of-the-art components to baseline single mode rocket engines, and is therefore relatively easy to develop for near term applications. The novelty of this invention resides in the mixing of
fuels before exhaust nozzle cooling. This allows all of the engine fuel to cool the exhaust nozzle, and allows the ratio of fuels used throughout the flight depend solely on performance requirements, not cooling requirements.
A catalyst is disclosed for the combination of CO and O₂ to form CO₂, which includes a platinum group metal (e.g., platinum); a reducible metal oxide having multiple valence states (e.g., SnO₂); and a compound which can bind water to its structure (e.g., silica gel). This catalyst is ideally suited for application to high-powered pulsed, CO₂ lasers operating in a sealed for closed-cycle condition.

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**INORGANIC AND PHYSICAL CHEMISTRY**

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

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coupled to an oscillograph for recording pressure traces generated by ignition.

METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N90-15227*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS Patent Application
DEBORAH DIANE SCHMIDT, inventor (to NASA), WENDY SUE ALTER, inventor (to NASA), and WILLIAM DAVID HAMILTON, inventor (to NASA) 7 Sep. 1989 13 p
CSCL 11F

This invention relates to the directional solidification of superalloys, in particular nickel-based superalloys, by imposition of a predetermined temperature profile in the solidification front and, depending on the desired results, a predetermined rate of advance of said solidification front, whereas castings of markedly superior fatigue resistance are produced.

A microporous structure with layered interstitial surface treatments, and the method and apparatus for its preparation are disclosed. The structure is prepared by sequentially subjecting a uniformly surface treated structure to atomic oxygen treatment to remove an outer layer of surface treatment to a generally uniform depth, and then surface treating the so exposed layer with another surface treating agent. The atomic oxygen/surface treatment steps may optionally be repeated, each successive time to a lesser depth, to produce a microporous structure having multilayered surface treatments. The apparatus employs at least one side arm from a main oxygen-containing chamber. The side arm has characteristic relaxation times such that a uniform atomic oxygen dose rate is delivered to a specimen positioned transversely in the side arm spaced from the main gas chamber.

A method of predicting aging of polymers operates by heating a polymer in the outdoors to an elevated temperature until a change of property is induced. The test is conducted at a plurality of temperatures to establish a linear Arrhenius plot which is extrapolated to predict the induction period for failure of the polymer at ambient temperature. An Outdoor Photo Thermal Aging Reactor (OPTAR) is also described including a heatable platen for receiving a sheet of polymer, means to heat the platen, and switching means.
27 NONMETALLIC MATERIALS

such as a photoelectric switch for turning off the heater during dark periods.

N90-15259*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WET SPINNING OF SOLID POLYAMIC ACID FIBERS Patent Application

The invention is a process for the production of solid aromatic polyamic acid and polyamide fibers from a wet gel or coagulation bath gel using N,N-dimethylacetamide (DMAc) solution of the polyamic acid derived from aromatic dianhydrides such as 3,3',4,4'-benzo phenone tetracarboxylic dianhydride (BTDA) and aromatic diamines such as 4,4'-oxydianiline (4,4'-ODA). By utilizing the interrelationship between coagulation medium and concentration, resin inherent viscosity, resin percent solids, filament diameter, and fiber void content, it is possible to make improved polyamic acid fibers. Solid polyamide fibers, obtained by the thermal cyclization of the polyamic acid precursor, have increased tensile properties compared to fibers containing macro pores from the same resin system.

N90-15260*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POLYMIDES WITH CARBONYL AND ETHER CONNECTING GROUPS BETWEEN THE AROMATIC RINGS Patent Application
PAUL M. HERGENROTHER, inventor (to NASA) and STEPHEN J. HAVENS, inventor (to NASA) (PRC Kentron, Inc., Hampton, VA.) 9 Nov. 1989 24 p

New polyimides have been prepared from the reaction of aromatic dianhydrides with novel aromatic diamines containing carbonyl and ether connecting groups between the aromatic rings. Several of these polyimides are shown to be semi-crystalline as evidenced by wide angle x ray diffraction and differential scanning calorimetry. Most of the polyimides form tough solvent resistant films with high tensile properties. Several of these materials can be thermally processed to form solvent and base resistant moldings.

N90-15261*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CERAMIC HEAT PIPE WICK Patent Application
BENJAMIN SEIDENBERG, inventor (to NASA) and THEODORE SWANSON, inventor (to NASA) 31 Jan. 1989 18 p

A wick for use in a capillary loop pump heat pipe is disclosed. The wick material is an essentially uniformly porous, permeable, open-cell, silicon dioxide/aluminum oxide inorganic ceramic foam having a silica fiber ratio, by weight, of about 78 to 22, respectively, a density of 6 lbs/cu ft, and an average pore size of less than 5 microns. A representative material having these characteristics is Lockheed Missile and Space Company, Inc.’s HTP 6-22. This material is fully compatible with the freons and anhydrous ammonia and allows for the use of these very efficient working fluids, and others, in capillary loops.

N90-15262*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
BROMINATED GRAPHTIZED CARBON FIBERS Patent Application
CHING-CHEN HUNG, inventor (to NASA) 30 Nov. 1989 13 p

Low cost, high break elongation graphitized carbon fibers having low degree of graphitization are inert to bromine at room or higher temperatures, but are brominated at -7 to 20 C, and then debrominated at ambient. Repetition of this bromination-debromination process can bring the bromine content to 18 percent. Electrical conductivity of the brominated fibers is
Highly conjugated organic polymers typically have large non-resonant electronic susceptibilities, which give the molecules unusual optical properties. To enhance these properties, defects are introduced into the polymer chain. Examples include light doping of the conjugated polymer and synthesis, conjugated polymers which incorporate either electron donating or accepting groups, and conjugated polymers which contain a photoexcitable species capable of reversibly transferring its electron to an acceptor. Such defects in the chain permit enhancement of the second hyperpolarizability by at least an order of magnitude.

Copolyimides are prepared by reacting one or more aromatic dianhydrides with a meta-substituted phenylene diamine and an aromatic bridged diamine. The incorporation of meta-substituted phenylene diamine derived units and bridged aromatic moieties. The resulting fluoropolymer product is closed celled with the cells storing the gas employed for foaming. The fluoropolymer resins employed may be any thermosetting fluoropolymer including fluoropolyether, fluoropolyurethanes and fluoropolyacrylates.

Copolyimides are prepared by reacting one or more aromatic dianhydrides with a meta-substituted phenylene diamine and an aromatic bridged diamine. The incorporation of meta-substituted phenylene diamine derived units and bridged aromatic moieties.
derived units into the linear aromatic polymer backbone results in a copolyimide of improved flexibility, processability, and melt-flow characteristics. The copolyimides are especially useful as thermoplastic hot-melt adhesives.

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ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N90-10310*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

ELECTROSTATICALLY SUSPENDED ROTOR FOR ANGULAR ENCODER Patent Application
WALTER POLSTORFF, inventor (to NASA) 21 Aug. 1989
35 p
(NASA-CASE-MFS-28294-1; NAS 1.71:MFS-28294-1;
CSCL 13H

An apparatus for engraving a code strip with coded markings is disclosed. The code strip is attached for rotation to a cylindrical rotor which is mounted within the cavity of a stator. The stator carries electrodes on its top and side walls to which high potentials are applied to electrostatically suspend the rotor. Circuit means sense the position of the rotor with respect to the stator electrodes and adjust the potential to maintain the rotor at its desired location. A drive motor is connected to the rotor through a drive shaft to initially locate the rotor into the desired location within the stator and to rotate it at the desired speed. Thereafter, the drive shaft is disconnected from the rotor, and the rotor continues to spin at a highly stable angular velocity, supported only by the electrostatic fields.

NASA

N90-19427* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

METHOD FOR MAINTAINING PRECISE SUCTION STRIP POROSITIES Patent
(NASA-CASE-LAR-13638-1; US-PATENT-4,851,071;
US-PATENT-CLASS-244-133; US-PATENT-CLASS-427-272)
Avail: US Patent and Trademark Office CSCL 13H

This invention relates to a masking method generally and, more particularly, to a method of masking perforated titanium sheets having laminar control suction strips. As illustrated in the drawings, a nonaerodynamic surface of a perforated sheet has alternating suction strip areas and bonding land areas. Suction strip tapes overlie the bonding land areas during application of a masking material to an upper surface of the suction strip tapes. Prior to bonding the perforated sheet to a composite structure, the bonding land tapes are removed. The entire opposite aerodynamic surface is masked with tape before bonding. This invention provides a precise control of suction strip porosities by ensuring that no chemicals penetrate the suction strip areas during bonding.

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

N90-19425* National Aeronautics and Space Administration. Pasadena Office, CA.

HIGH DENSITY TAPE CASTING SYSTEM Patent
(NASA-CASE-NPO-16901-1-CU; US-PATENT-4,839,121;

A system is provided for casting thin sheets (or tapes) of particles bound together, that are used for oxygen membranes and other applications, which enables the particles to be cast at a high packing density in a tape of uniform thickness. A slurry contains the particles, a binder, and a solvent, and is cast against the inside walls of a rotating chamber. Prior to spraying the slurry against the chamber walls, a solvent is applied to a container. The solvent evaporates to saturate the chamber with solvent vapor. Only then is the slurry cast. As a result, the slurry remains fluid long enough to spread evenly over the casting surface formed by the chamber, and for the slurry particles to become densely packed. Only then is the chamber vented to remove solvent, so the slurry can dry. The major novel feature is applying solvent vapor to a rotating chamber before casting slurry against the chamber walls.

Official Gazette of the U.S. Patent and Trademark Office
COMMUNICATIONS AND RADAR

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

N90-16104*# National Aeronautics and Space Administration. Pasadena Office, CA.
STRIPLINE FEED FOR A MICROSTRIP ARRAY OF PATCH ELEMENTS WITH TEARDROP SHAPED PROBES Patent Application
JOHN HUANG, inventor (to NASA) 7 Sep. 1989 24 p
(Contract NAS7-918)

A circularly polarized microstrip array antenna utilizing a honeycomb substrate made of dielectric material to support on one side the microstrip patch elements in an array, and on the other side a stripline circuit for feeding the patch elements in subarray groups of four with angular orientation and phase for producing circularly polarized radiation, preferably at 0, 90, 180, and 270 degree relationship is described. The probe used for coupling each feed point in the stripline circuit to a microstrip patch element is teardrop shaped in order to introduce capacitance between the coupling probe and the metal sheet of the stripline circuit that serves as an antenna ground plane. The capacitance thus introduced tunes out inductance of the probe. The shape of the teardrop probe is not critical. The probe capacitance required is controlled by the maximum diameter for the teardrop shaped probe, which can be empirically determined for the operating frequency. An aluminum baffle around each subarray blocks out surface wave between subarrays.

N90-16975*# National Aeronautics and Space Administration. Pasadena Office, CA.
PHASE AMBIGUITY RESOLUTION FOR OFFSET QPSK MODULATION SYSTEMS Patent Application
TIEN M. NGUYEN, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 30 Nov. 1989 35 p
(Contract NAS7-918)

A demodulator for Offset Quaternary Phase Shift Keyed (OQPSK) signals modulated with two words resolves eight possible combinations of phase ambiguity which may produce data error by first processing received I(sub R) and Q(sub R) data in an integrated carrier loop/symbol synchronizer using a digital Costas loop with matched filters for correcting four of eight possible phase lock errors, and then the remaining four using a phase ambiguity resolver which detects the words to not only reverse the received I(sub R) and Q(sub R) data channels, but to also invert (complement) the I(sub R) and/or Q(sub R) data, or to at least complement the I(sub R) and Q(sub R) data for systems using nontransparent codes that do not have rotation direction ambiguity.

N90-17005* National Aeronautics and Space Administration. Pasadena Office, CA.
APPARATUS FOR USING A TIME INTERVAL COUNTER TO MEASURE FREQUENCY STABILITY Patent

An apparatus for measuring the relative stability of two signals algorithms modified so as to control weight changes due to circuit drift.

NASA
is disclosed comprising a means for mixing the two signals down to a beat note sine wave and for producing a beat note square wave whose upcrossings are the same as the sine wave. A source of reference frequency is supplied to a clock divider and interval counter to synchronize them and to generate a picket fence for providing a time reference grid of period shorter than the beat period. An interval counter is employed to make a preliminary measurement between successive upcrossings of the beat note square wave for providing an approximate time interval therebetween as a reference. The beat note square wave and the picket fence are then provided to the interval counter to provide an output consisting of the time difference between the upcrossing of each beat note square wave cycle and the next picket fence pulse such that the counter is ready for each upcrossing and dead time is avoided. A computer containing an algorithm for calculating the exact times of the beat note upcrossings then computes the upcrossing times.

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33 ELECTRONICS AND ELECTRICAL ENGINEERING

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

N90-10329# National Aeronautics and Space Administration. Pasadena Office, CA.
LATERALLY STACKED SCHOTTKY DIODES FOR INFRARED SENSOR APPLICATIONS Patent Application

Laterally stacked Schottky diodes for infrared sensor applications are fabricated utilizing porous silicon having pores. A Schottky metal contact is formed in the pores, such as by electroplating. The sensors may be integrated with silicon circuits on the same chip with a high quantum efficiency, which is ideal for IR focal plane array applications due to uniformity and reproducibility.

N90-16124# National Aeronautics and Space Administration. Pasadena Office, CA.
ORGANIC CATHODE FOR A SECONDARY BATTERY Patent Application
RATNAKUMAR V. BUGGA, inventor (to NASA), SALVADOR DISTEFANO, inventor (to NASA), ROGER M. WILLIAMS, inventor (to NASA), and CLYDE P. BANKSTON, inventor (to NASA) 7 Sep. 1989 20 p (Contract NAS7-918) (NASA-CASE-NPO-17604-1-CU; NAS 1.71:NPO-17604-1-CU; US-PATENT-APPL-SN-404288) Avail: NTIS HC A03/MF A01 CSCL 09A

A liquid catholyte for a battery based on liquid metal such as sodium anode and a solid, ceramic separator such as beta alumina (BASE) comprises a mixture of a Group I-III metal salt such as sodium tetrachloroaluminate and a minor amount of an organic carbonitrile depolarizer having at least one adjacent ethylenic band such as 1 to 40 percent by weight of tetracyanoethylene. The tetracyanoethylene forms an adduct with the molten metal salt.
A protective device for one battery or serially arranged battery cells is disclosed and is adapted to fit between one battery and its terminal connector or between adjacent battery cells. The device incorporates a disk of positive temperature coefficient material having a pair of circular end faces for contact. The disk is supported by a ring adhesively joined thereto, the ring having a central axial opening to enable the button terminal of a battery cell to contact against the disk as the disk and battery cell are arranged in a single battery application or in serial contact with similar battery cells.

Monolithic microwave integrated circuit (MMIC) test includes a bias module having spring-loaded contacts which electrically engage member. RF frequency is applied to and passed from the chip carrier by chamfered edges of ridges in the waveguide passages of housings which are removably attached to the base member. Thru, Delay, and Short calibration standards having dimensions identical to those of the chip carrier assure accuracy and reliability of the test. The MMIC chip fits in an opening in the chip carrier with the boundaries of the MMIC lying on movable reference planes thereby establishing accuracy and flexibility.

A bistable switching element is made of a material whose electrical resistance reversibly decreases in response to intercalation by positive ions. Flow of positive ions between the bistable switching element and a positive ion source is controlled by means of an electrical potential applied across a thermal switching element. The material of the thermal switching element generates heat in response to electrical current flow therethrough, which in turn causes the material to undergo a thermal phase transition from a high electrical resistance state to a low electrical resistance state as the temperature increases above a predetermined value. Application of the electrical potential in one direction renders the thermal switching element conductive to pass electron current out of the ion source. This causes positive ions to flow from the source into the bistable switching element and intercalate the same to produce a non-volatile, low resistance logic state. Application of the electrical potential in the opposite direction causes reverse current flow which de-intercalates the...
bistable logic switching element and produces a high resistance logic state.

N90-17011*# National Aeronautics and Space Administration. Pasadena Office, CA.

COPPER CHLORIDE CATHODE FOR A SECONDARY BATTERY Patent Application

RATNAKUMAR V. BUGGA, inventor (to NASA), SALVADOR DISTEFANO, inventor (to NASA), GANESAN NAGASUBRAMIAN, inventor (to NASA), and CLYDE P. BANKSTON, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.)

11 Sep. 1989 13 p

Higher energy and power densities are achieved in a secondary battery based on molten sodium and a solid, ceramic separator such as a beta alumina and a molten catholyte such as sodium tetrachloroaluminate and a copper chloride cathode. The higher cell voltage of copper chloride provides higher energy densities and the higher power density results from increased conductivity resulting from formation of copper as discharge proceeds.

A digitally controlled resistance generator is described, in which resistors having values selected according to an expression $2^{(N-1)}R$, where $N$ is equal to the number of terms in the expression, and $R$ is equal to the lowest value of resistance, are electrically inserted into a resistive circuit in accordance with a parallel binary signal provided by an analog-to-digital converter or a programmable computer. This binary signal is coupled via optical isolators which, when activated by a logical 1, provides a negative potential to some or all of the gate inputs of the normally on field effect transistors which, when on, shorts out the associated resistor. This applied negative potential turns the field effect transistors off and electrically inserts the resistor coupled between the source terminal and the drain terminal of that field effect transistor into the resistive circuit between the terminals.

A DIGITALLY CONTROLLED SYSTEM FOR EFFECTING AND PRESENTING A SELECTED ELECTRICAL RESISTANCE Patent

JAMES C. FLETCHER, inventor (to NASA) and WALTER L. ROSS, inventor (to NASA) (Rockwell International Corp., Pittsburgh, PA.)


A low noise, variable discharge area, valve is constructed having opposed recesses within which a pair of gates are slidably disposed. Each of the gates is provided with upstream edges having a radius thereon, the radius enabling smooth, accelerated, low noise flow therebetween. The gates are further provided with tracks along each side, which in turn slide along splines set in the side walls of the valve. A threaded rod which rotates in a threaded insert in a rear wall of each of the gates, serves to

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34 FLUID MECHANICS AND HEAT TRANSFER

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

N90-17051*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

LOW-NOISE NOZZLE VALVE Patent Application

HAL S. GWIN, inventor (to NASA) and JAMES AARON, inventor (to NASA) 7 Sep. 1989 15 p

A low noise, variable discharge area, valve is constructed having opposed recesses within which a pair of gates are slidably disposed. Each of the gates is provided with upstream edges having a radius thereon, the radius enabling smooth, accelerated, low noise flow therebetween. The gates are further provided with tracks along each side, which in turn slide along splines set in the side walls of the valve. A threaded rod which rotates in a threaded insert in a rear wall of each of the gates, serves to
move the gates within their respective recesses.

N90-19534* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**METHOD AND APPARATUS FOR DETECTING LAMINAR FLOW SEPARATION AND REATTACHMENT Patent**


The invention is a method and apparatus for detecting laminar flow separation and flow reattachment of a fluid stream by simultaneously sensing and comparing a plurality of output signals, each representing the dynamic shear stress at one of an equal number of sensors spaced along a straight line on the surface of an airfoil or the like that extends parallel to the fluid stream. The output signals are concurrently compared to detect the sensors across which a reversal in phase of said output signal occurs, said detected sensors being in the region of laminar separation or reattachment. The novelty in this invention is the discovery and use of the phase reversal phenomena to detect laminar separation and attachment of a fluid stream from any surface such as an airfoil supported therein.

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N90-17104* National Aeronautics and Space Administration. Pasadena Office, CA.

**BALLAST SYSTEM FOR MAINTAINING CONSTANT PRESSURE IN A GLOVE BOX Patent Application**

PAUL J. SHLICHTA, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena,) 29 Sep. 1989 13 p (Contract NAS7-918)


A ballast system is disclosed for a glove box including a fixed platform on which is mounted an inflatable bag on top of which resides a cover and a weight. The variable gas volume of the inflatable bag communicates with that of the glove box via a valved tube. The weight and the gas volume are selected to maintain a relatively constant pressure in the glove box despite variations in
the glove box volume while avoiding the use of complicated valving apparatus.

**SKIN FRICTION BALANCE Patent**

TCHENG PING, inventor (to NASA) and FRANK H. SUPPLEE, JR., inventor (to NASA) 6 Jun. 1989 9 p Filed Jun. 23, 1988

Supersedes NASA-17117


A skin friction balance uses a parallel linkage mechanism to avoid inaccuracies in skin friction measurement attributable to off-center normal forces. The parallel linkage mechanism includes a stationary plate mounted in a cage, and an upper and lower movable plate which are linked to each other and to the stationary plate through three vertical links. Flexure pivots are provided for pivotally connecting the links and the plates. A sensing element connected to the upper plate moves in response to skin friction, and the lower plate moves in the opposite direction of the upper plate. A force motor maintains a null position of the sensing element by exerting a restoring force in response to a signal generated by a linear variable differential transformer (LVDT).

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

**TAILORABLE INFRARED SENSING DEVICE WITH STRAIN LAYER SUPERLATTICE STRUCTURE Patent**


Laser pyrometer techniques are utilized to accurately image a true temperature distribution on a given target without touching the target and without knowing the localized emissivity of the target. The pyrometer utilizes a very high definition laser beam and photodetector, both having a very narrow focus. The pyrometer is mounted in a mechanism designed to permit the pyrometer to be aimed and focused at precise localized points on the target surface. The pyrometer is swept over the surface area to be imaged.

**NONCONTACT TEMPERATURE PATTERN MEASURING DEVICE Patent**

DANIEL D. ELLEMAN, inventor (to NASA), JAMES L. ALLEN, inventor (to NASA), and MARK C. LEE, inventor (to NASA) (California Inst. of Tech., Pasadena.) 20 Jun. 1989 11 p Filed Feb. 23, 1988


Laser pyrometer techniques are utilized to accurately image a true temperature distribution on a given target without touching the target and without knowing the localized emissivity of the target. The pyrometer utilizes a very high definition laser beam and photodetector, both having a very narrow focus. The pyrometer is mounted in a mechanism designed to permit the pyrometer to be aimed and focused at precise localized points on the target surface. The pyrometer is swept over the surface area to be imaged.

**LASERS AND MASERS**

Includes parametric amplifiers.
MECHANICAL ENGINEERING

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

N90-15442* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SINGLE ELEMENT MAGNETIC SUSPENSION ACTUATOR Patent Application

The invention, a single element magnetic suspension actuator with bidirectional force capability along a single axis, includes an electromagnet and a nonmagnetic suspended element. A permanent magnet mounted on the suspended element interacts with a magnetic field established by the electromagnet to produce bidirectional forces in response to a variable force command voltage V(sub FC) applied to the electromagnet. A sensor measures the position of the suspended element on the single axis which is a function of force command voltage V(sub FC).

N90-15443* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
HYBRID BUTTERFLY VALVE Patent Application

A hybrid butterfly valve has a stationary seat and a valve closure disk which may rotate together with an actuating shaft from the fully open position to a position wherein the disk is aligned with the seat, and may be moved linearly into a sealing relationship with the seat. The disk is supported by brackets having an elongated slot through which the shaft extends, the brackets being adapted to move linearly relative to the shaft. Cams fastened to the shaft initiate a 90 degree rotation of the disk from the fully open position to the position where the valve disk is aligned with the seat, and the cams act in conjunction with followers carried by the disk to move the disk and the brackets linearly. The disk carries guide members which are positioned in a guide slot, the guide slot having an arcuate portion and a linear portion, and the disk is guided by the guide members guided in the arcuate portion when the disk is fully opened to and until the disk is aligned with the seat, and the guide members are guided by the linear portion of the slot. A portion of each cam is spring biased so that the cams tightly engage follower rollers carried by the brackets during the rotational portion of the movement of the disk.

N90-15444* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH TEMPERATURE, FLEXIBLE, THERMAL BARRIER SEAL Patent Application

This device seals the sliding interfaces between structural panels that are roughly perpendicular to each other or whose edges are butted against one another. The nonuniformity of the gap between the panels requires significant flexibility along the seal length. The seal is mounted in a rectangular groove in a moveable structural panel. A plurality of particles or balls is densely packed in an outer sheathing. The balls are laterally preloaded to maintain sealing contact with the adjacent wall using a pressurized linear bellows. Distortions in the adjacent panel are accommodated by rearrangement of the particles within the outer sheathing. Leakage through the seal is minimized by densely compacting the internal particles and by maintaining positive preload along the back side of the seal. The braid architecture of the outer sheathing
is selected to minimize leakage through the seal and to resist mechanical abrasion.

FULLY ARTICULATED FOUR-POINT-BEND LOADING FIXTURE Patent Application
ANTHONY M. CALOMINO, inventor (to NASA)  28 Dec. 1989  11 p
A fully articulated four-point bending fixture for Modulus of Rupture (MOR) and fracture toughness specimens utilizes an upper loading plate in combination with a lower loading plate. The lower plate has a pair of spring loaded ball bearings which seat in V-shaped grooves located in the upper plate. The ball bearings are carried in the arms of the lower plate. A load is applied to the specimen through steel rollers, one large roller and one smaller roller each located on both the upper and lower plates. The large rollers have needle roller bearings which enable a single loading roller to rotate relative to the plate to which it is attached.

METHOD AND APPARATUS FOR POSITIONING A ROBOTIC END EFFECTOR Patent Application
CLIFF HESS, inventor (to NASA) and LARRY C. H. Li, inventor (to NASA)  10 Aug. 1989  24 p
(NASA-CASE-MSC-21476-1; US-PATENT-APPL-SN-392235) Avail: NTIS HC A03/MF A01 CSCL 131
A robotic end effector and operation protocol for a reliable grasp of a target object irrespective of the target’s contours is disclosed. A robotic hand includes a plurality of jointed fingers, one of which, like a thumb, is in opposed relation to the other. Each finger is comprised of at least two jointed sections, and provided with reflective proximity sensors, one on the inner surface of each finger section. Each proximity sensor comprises a transmitter of a beam of radiant energy and means for receiving reflections of the transmitted energy when reflected by a target object and for generating electrical signals responsive thereto. On the fingers opposed to the thumb, the proximity sensors on the outermost finger sections are aligned in an outer sensor array and the sensors on the intermediate finger sections and sensors on the innermost finger sections are similarly arranged to form an
intermediate sensor array and an inner sensor array, respectively. The invention includes a computer system with software and/or circuitry for a protocol comprising the steps in sequence of: (1) approach axis alignment to maximize the number of outer layer sensors which detect the target; (2) non-contact contour following the target by the robot fingers to minimize target escape potential; and (3) closing to rigidize the target including dynamically re-adjusting the end effector finger alignment to compensate for target motion. A signal conditioning circuit and gain adjustment means are included to maintain the dynamic range of low power reflection signals.

gear in mesh with the integral peripheral spur gear. The drive motor is torque, speed, and direction controllable.
N90-17154* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL. 
RELEASABLE CLAMPING APPARATUS Patent 
W. NEILL MYERS, inventor (to NASA) 6 Jun. 1989 11 p 
Filed Sep. 24, 1987 
(NASA-CASE-MFS-28192-1; US-PATENT-4,836,707; 

In accordance with this invention, a releasable clamping apparatus was constructed having an opening or slot within which a lifting handle is clamped between retaining latch portions and a clamp assembly. The latch portions are supported by openings and are retracted and extended into a slot by spring biased linkage members. These members are acted upon by similarly profiled cam lobes. Dissimilarly profiled cam lobes of the cam member act upon the clamp assembly, clamping a handle against faces of the latch portions. The cam member is coupled to a shaft having an operating handle with the shaft also being provided with a detent assembly. This detent assembly locks the handle and the shaft in locked positions in the surface of the apparatus, which clamps a handle as described. When the handle is rotated to position the detent assembly is one of the release openings, the clamp assembly and the latch portions are withdrawn into their respective openings, releasing the handle.

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N90-19602* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL. 
TRAILER SHIELD ASSEMBLY FOR A WELDING TORCH Patent 
Filed 16 Feb. 1988 
(NASA-CASE-MFS-29260-1; US-PATENT-4,839,489; 

This invention relates generally to trailer shields for gas shielded arc welding torches, and more particularly to a trailer shield assembly provided with a shield gas manifold for providing an even dispersion of shield gas to the interior of the shield assembly, which generally encloses a joint being welded and a welding trailing portion of hot welded metal. The novelty of the invention lies in providing trailer shield with a manifold tube having a plurality of openings from which shield gas is distributed. A gas manifold region ahead of the torch is also provided with shield gas from a tube to protect metal preheated by the torch. Further novelty lies in constructing portions of sides and housing and portions of side walls of the guide of stainless steel screen having a tight mesh.

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

N90-17252* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. 
BIO-REACTOR CHAMBER Patent 
JOSEPH A. CHANDLER, inventor (to NASA) 13 Jun. 1989 9 p 
Filed Aug. 20, 1987 
(NASA-CASE-MSC-20929-1; US-PATENT-4,839,046; 

A bioreactor for cell culture is disclosed which provides for the introduction of fresh medium without excessive turbulent action. The fresh medium enters the bioreactor through a filter with a backwash action which prevents the cells from settling on the filter. The bioreactor is sealed and depleted medium is forced out of the container as fresh medium is added.

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The present invention relates to a 3-dimensional co-culture process, more particularly to methods or co-culturing at least two types of cells in a culture environment, either in space or in unit gravity, with minimum shear stress, freedom for 3-dimensional spatial orientation of the suspended particles and localization of particles with differing or similar sedimentation properties in a similar spatial region to form 3-dimensional tissue-like structures. Several examples of multicellular 3-dimensional experiences are included. The protocol and procedure are also set forth. The process allows simultaneous culture of multiple cell types and supporting substrates in a manner which does not disrupt the 3-dimensional spatial orientation of these components. The co-cultured cells cause a mutual induction effect which mimics the natural hormonal signals and cell interactions found in the intact organism. This causes the tissues to differentiate and form higher 3-dimensional structures such as glands, junctional complexes, polypoid in-vitro tissue. The process provides enhanced 3-dimensional tissue-like structure and biochemical signals and cell interactions found in the intact organism. This increased 3-dimensional tissue-like structure and biochemical evidence of an increased differentiation state. With the present invention a variety of cells may be co-cultured to produce tissue which has 3-dimensionality and has some of the characteristics of in-vitro tissue. The process provides enhanced 3-dimensional tissue which create a multicellular organoid differentiation model.

A reflection-mode ultrasonic system uses time-delay spectroscopy (TDS) for imaging of variations in a property of deep arterial and coronary tissue within a volume at a range from a transmitting transducer. A receiving transducer mounted concentric with the transmitting transducer provides a return signal that is demodulated by the sweep of the TDS using a balanced mixer to present a complex signal representative of a property within a volume of tissue. The complex signal is amplified and filtered before mixing with a frequency signal from a local generator to establish a zero range reference for A-scan display of the return signal, but before display the offset return signal is transformed by a fast Fourier transform processor from the frequency domain to a time domain to present the return signal for display as a time-based range signal. A B-scan display may be provided by additionally scanning the transducers in a linear path across the tissue.
and graphics developments and includes the ability of log file comparisons.

A bus programmable slave module card for use in a computer control system is disclosed which comprises a master computer and one or more slave computer modules interfacing by means of a bus. Each slave module includes its own microprocessor, memory, and control program for acting as a single loop controller. The slave card includes a plurality of memory means (S1, S2...) corresponding to a like plurality of memory devices (C1, C2...) in the master computer, for each slave memory means its own communication lines connectable through the bus with memory communication lines of an associated memory device in the master computer, and a one-way electronic door which is switchable to either a closed condition or a one-way open condition. With the door closed, communication lines between master computer memory (C1, C2...) and slave memory (S1, S2...) are blocked. In the one-way open condition invention, the memory communication lines of each slave memory means (S1, S2...) connect with the memory communication lines of its associated memory device (C1, C2...) in the master computer, and the memory devices (C1, C2...) of the master computer and slave card are electrically parallel such that information seen by the master's memory is also seen by the slave's memory. The slave card is also connectable to a switch for electronically removing the slave microprocessor from the system. With the master computer and the slave card in programming mode relationship, and the slave microprocessor electronically removed from the system, loading a program in the memory devices (C1, C2...) of the master accomplishes a parallel loading into the memory devices (S1, S2...) of the slave.

A method and associated apparatus are disclosed for finding the lowest cost path of several variable paths. The paths are comprised of a plurality of linked cost-incurring areas existing between an origin point and a destination point. The method comprises the steps of, connecting a plurality of nodes together in the manner of the cost-incurring areas; programming each node to have a cost associated therewith corresponding to one of the cost-incurring areas; injecting a signal into one of the nodes representing the origin point; propagating the signal through the plurality of nodes from inputs to outputs; reducing the signal in magnitude at each node as a function of the respective cost of the node; and, starting at one of the nodes representing the destination point and following a path having the least reduction in magnitude of the signal from node to node back to one of the nodes representing the origin point whereby the lowest cost path is found.
from the origin point to the destination point is found.

This invention is a redundant error detecting and correcting local area networked computer system having a plurality of nodes each including a network connector board within the node for connecting to an interfacing transceiver operably attached to a network cable. There is a first network cable disposed along a path to interconnect the nodes. The first network cable includes a plurality of first interfacing transceivers attached thereto. A second network cable is disposed in parallel with the first cable and, in like manner, includes a plurality of second interfacing transceivers attached thereto. There are a plurality of three position switches each having a signal input, three outputs for individual selective connection to the input, and a control input for receiving signals designating which of the outputs is to be connected to the signal input. Each of the switches includes means for designating a response address for responding to addressed signals appearing at the control input and each of the switches further has its signal input connected to a respective one of the input/output lines from the nodes. Also, one of the three outputs is connected to a respective one of the plurality of first interfacing transceivers. There is master switch control means having an output connected to the control inputs of the plurality of three position switches and an input for receiving directive signals for outputting addressed switch position signals to the three position switches as well as monitor and control computer means having a pair of network connector boards therein connected to respective ones of one of the first interfacing transceivers and one of the second interfacing transceivers and an output connected to the input of the master switch means for monitoring the status of the networked computer system by sending messages to the nodes and receiving and verifying messages therefrom and for sending control signals to the master switch to cause respective ones of the nodes to use a desired one of the first and second cables for transmitting and receiving messages and for disconnecting desired ones of the nodes from both cables.
ACOUSTICS

Includes sound generation, transmission, and attenuation.

N90-12289* National Aeronautics and Space Administration. Pasadena Office, CA.

ACOUSTIC CONTROLLED ROTATION AND ORIENTATION Patent


Acoustic energy is applied to a pair of locations spaced about a chamber, to control rotation of an object levitated in the chamber. Two acoustic transducers applying energy of a single acoustic mode, one at each location, can (one or both) serve to levitate the object in three dimensions as well as control its rotation. Slow rotation is achieved by initially establishing a large phase difference and/or pressure ratio of the acoustic waves, which is sufficient to turn the object by more than 45 deg, which is immediately followed by reducing the phase difference and/or pressure ratio to maintain slow rotation. A small phase difference and/or pressure ratio enables control of the angular orientation of the object without rotating it. The sphericity of an object can be measured by its response to the acoustic energy.

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N90-17408* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

METHOD AND APPARATUS FOR CHARACTERIZING REFLECTED ULTRASONIC PULSES Patent Application


The invention is a method of and apparatus for characterizing the amplitudes of a sequence of reflected pulses R1, R2, and R3 by converting them into corresponding electric signals E1, E2, and E3 to substantially the same value during each sequence thereby restoring the reflected pulses R1, R2, and R3 to their initial reflection values by timing means, an exponential generator, and a time gain compensator. Envelope and baseline reject circuits permit the display and accurate location of the time spaced sequence of electric signals having substantially the same amplitude on a measurement scale on a suitable video display or oscilloscope.

N90-15710*# National Aeronautics and Space Administration.

SOUND ATTENUATION APPARATUS Patent Application


An apparatus is disclosed for reducing acoustic transmission from mechanical or acoustic sources by means of a double wall partition, within which an acoustic pressure field is generated by at least one secondary acoustic source. The secondary acoustic source is advantageously placed within the partition, around its edges, or it may be an integral part of a wall of the partition.

N90-15723*# National Aeronautics and Space Administration.

FIBER OPTIC SENSING SYSTEM Patent Application

GRIGORY ADAMOVSKY, inventor (to NASA) 7 Sep. 1989 14 p

OPTICS

Includes light phenomena; and optical devices.

N90-15723*# National Aeronautics and Space Administration.

FIBER OPTIC SENSING SYSTEM Patent Application

GRIGORY ADAMOVSKY, inventor (to NASA) 7 Sep. 1989 14 p
A fiber optic interferometer utilizes a low coherence light emitting diode (LED) laser as a light source which is filtered and driven at two RF frequencies, high and low, that are specific to the initial length of the resonator chamber. A displacement of a reflecting mirror changes the length traveled by the nonreferencing signal. The low frequency light undergoes destructive interference which reduces the average intensity of the wave while the high frequency light undergoes constructive interference which increases the average intensity of the wave. The ratio of these two intensity measurements is proportional to the displacement incurred.

PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

An improved plasma gun coaxially injects particles of ceramic materials having high melting temperatures into the central portion of a plasma jet. This results in a more uniform and higher temperature and velocity distribution of the sprayed particles. The position of the cathode is adjustable to facilitate optimization of the performance of the gun wherein grains of the ceramic material are melted at lower power input levels.
SOLID-STATE PHYSICS

Includes superconductivity.

METHOD OF FORMING LOW COST, FORMABLE HIGH T(SUBC) SUPERCONDUCTING WIRE Patent Application
JAMES L. SMIALEK, inventor (to NASA) 28 Dec. 1989 9 p
Sponsored by NASA

A ceramic superconductivity part, such as a wire, is produced through the partial oxidation of a specially formulated copper alloy in a core. The alloys contain low levels of quantities of rare earth and alkaline earth dopant elements. Upon oxidation at high temperatures, and superconducting oxide phases are formed as a thin film.

FABRICATION OF NANOMETER SINGLE CRYSTAL METALLIC COSi2 STRUCTURES ON SI Patent Application
SIMON K. W. NIEH, inventor (to NASA), TRUE-LON LIN, inventor (to NASA), and ROBERT W. FATHAUER, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 10 Aug. 1989 12 p
(Contract NAS7-918)

Amorphous Co:Si (1:2 ratio) films are electron gun-evaporated on clean Si(111) substrates, such as in a molecular beam epitaxy system. These layers are then crystallized selectively with a focused electron beam to form very small crystalline CoSi2 regions in an amorphous matrix. Finally, the amorphous regions are etched away selectively using plasma or chemical techniques.

ANNEALING GROUP III-V COMPOUND DOPED SILICON-GERMANIUM ALLOY FOR IMPROVED THERMO-ELECTRIC CONVERSION EFFICIENCY Patent
JAN W. VANDERSANDE, inventor (to NASA), CHARLES WOOD, inventor (to NASA), and SUSAN L. DRAPER, inventor (to NASA) (California Inst. of Tech., Pasadena.) 18 Jul. 1989 8 p Filed 21 Apr. 1988

The thermoelectric conversion efficiency of a GaP doped SiGe alloy is improved about 30 percent by annealing the alloy at a temperature above the melting point of the alloy, preferably stepwise from 1200 C to 1275 C in air to form large grains having a size over 50 microns and to form a GeGaP rich phase and a silicon rich phase containing SiP and SiO2 particles.

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

NASA patent application specifications are sold in paper copy and microfiche by the National Technical Information Service. The US-Patent-Appl-SN-number should be used in ordering either paper copy or microfiche from NTIS.

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 National Technical Information Service (NTIS) on standing order subscription as PB 90-911100 at the price of $15.00 domestic and $30.00 foreign. Standing order subscriptions do not terminate at the end of a year, as do regular subscriptions, but continue indefinitely unless specifically terminated by the subscriber.
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<th>NASA Case Number</th>
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<td>ARC-xxxxx</td>
<td>Ames Research Center Mail Code: 200-11A Moffett Field, California 94035 Telephone: (415) 694-5104</td>
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<td>ERC-xxxxx</td>
<td>Goddard Space Flight Center Mail Code: 204 Greenbelt, Maryland 20771 Telephone: (301) 286-7351</td>
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<td>John F. Kennedy Space Center Mail Code: PT-PAT Kennedy Space Center, Florida 32899 Telephone: (305) 867-2544</td>
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<td>HQN-xxxxx</td>
<td>Langley Research Center Mail Code: 279 Hampton, Virginia 23365 Telephone: (804) 865-3725</td>
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<td>XHQ-xxxxx</td>
<td>Lewis Research Center Mail Code: 500-318 21000 Brookpark Road Cleveland, Ohio 44135 Telephone: (216) 433-5753</td>
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<td>GSC-xxxxx</td>
<td>Lyndon B. Johnson Space Center Mail Code: AL3 Houston, Texas 77058 Telephone: (713) 483-4871</td>
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<td>XGS-xxxxx</td>
<td>George C. Marshall Space Flight Center Mail Code: CC01 Huntsville, Alabama 35812 Telephone: (205) 544-0024</td>
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<td>KSC-xxxxx</td>
<td>NASA Resident Legal Office Mail Code: 180-801 4800 Oak Grove Drive Pasadena, California 91103 Telephone: (818) 354-2700</td>
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PATENT LICENSING REGULATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

14 CFR Part 1245

 Licensing of NASA Inventions

AGENCY: National Aeronautics and Space Administration

ACTION: Interim regulation with comments requested.

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

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

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

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

SUPPLEMENTARY INFORMATION:

PART 1245—PATENTS AND OTHER INTELLECTUAL PROPERTY RIGHTS

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

Subpart 2—Licensing of NASA Inventions

Sec.
1245.200 Scope of subpart.
1245.201 Policy and objective.
1245.202 Definitions.
1245.203 Authority to grant licenses.

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.

Authority: 35 U.S.C. Section 207 and 208.94 Stat 3023 and 3024.

Subpart 2—Licensing of NASA Inventions

§ 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 condition, as to establish that the invention is being utilized and that its benefits are to the extent permitted by law or Government regulations available to the public on reasonable terms.

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

§ 1245.203 Authority to grant licenses.

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

Restrictions and Conditions

§ 1245.204 All licenses granted under this subpart.

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

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

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

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

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

(3) The license may extend to subsidiaries of the licensee or other parties if provided for in the license but shall not 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 sublicensee shall make reference to the license, including the rights retained by the Government, and a copy of such sublicense shall be furnished to NASA.

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

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

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

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

(9) The license shall provide for the right of NASA to terminate the license, in whole or in part, if:

(i) NASA determines that the licensee is not executing the plan submitted with its request for a license and the licensee cannot otherwise demonstrate to the satisfaction of NASA that it has taken or can be expected to take within a reasonable time effective steps to achieve practical application of the invention;

(ii) NASA determines that such action is necessary to meet requirements for public use specified by Federal regulations issued after the date of the license and such requirements are not reasonably satisfied by the licensee;

(iii) The licensee has willfully made a false statement of or willfully omitted a material fact in the license application or in any report required by the license agreement; or

(iv) The licensee commits a substantial breach of a covenant or agreement contained in the license.

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

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

Types of Licenses

§ 1245.205 Nonexclusive licenses.

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

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

§ 1245.206 Exclusive and partially exclusive licenses.

(a) Domestic licenses.

(1) Availability of licenses. Exclusive or partially exclusive licenses may be granted on NASA inventions: (i) 3 months after notice of the invention's availability has been announced in the Federal Register; or (ii) without such notice where NASA determines that expeditious granting of such a license will best serve the interests of the Federal Government and the public; and (iii) in either situation, specified in (a)(1)(i) or (ii) of this section only if:

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

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

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

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

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

(b) Foreign licenses.

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

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

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

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

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

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

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

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

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

Procedures

§ 1245.207 Application for a license.

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

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

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

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

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

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

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

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

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

(2) A statement as to applicant's capability and intention to fulfill the plan, including information 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 any 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 Assistant General Counsel for Patent Matters. Such review and final recommendation may include, and be based on, any additional information obtained from applicant and other sources that the Patent Counsel and the Director of Licensing deem relevant to the license requested. The determination to grant or deny the license shall be made by the Assistant General Counsel for Patent Matters based on the final recommendation of the Director of Licensing.

(b) When notice of a prospective exclusive or partially exclusive license is published in the Federal Register in accordance with § 1245.206(a)(1)(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 Assistant General Counsel for Patent Matters.

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

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

§ 1245.209 Notice to Attorney General.

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

[FR Doc. 81-31009 Filed 10-30-81; 5:45 am]

BILLING CODE 7510-01-M
Abstracts are provided for 76 patents and patent applications entered into the NASA scientific and technical information system during the period January 1990 through June 1990. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application.