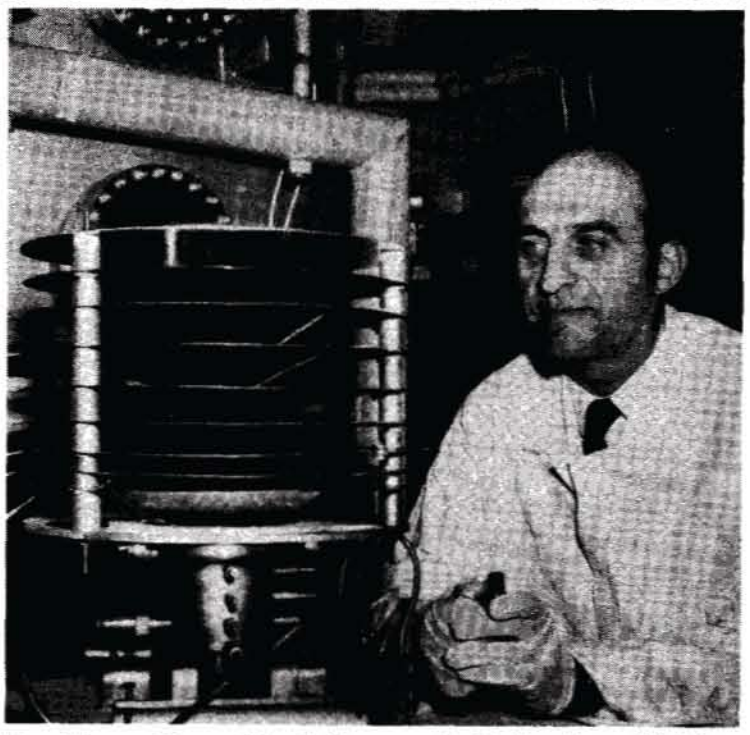
LEWIS RESEARCH CENTER
CLEVELAND OHIO

NASA

May 7, 1971



Dr. Henry Kosmahl of Spacecraft Technology Division heads section that developed superefficiency tube.
(Martin Brown photo)

Technology satellite to test Lewis tube for space broadcast

A highly advanced type of tube for amplifying radio and television signals is being developed by Lewis for an international experimental communications satellite.

The Lewis tube, more efficient and powerful than any in space today, will operate at 12 GigaHertz in the Super High Frequency (SHF) band. "The lower frequency band is very crowded today," says Elmer Davison, manager of the project for Lewis. "The high power tube will help make the upper part of the frequency spectrum available for microwave transmission."

The satellite that will use the tube is the Communications Technology Satellite, a cooperative U.S. — Canadian project. Scheduled to be flown in 1974, it will test new technology and techniques for broadcast distribution from space, particularly to isolated regions such as small villages in the north of Canada and Alaska. The experimental satellite will transmit television and audio signals to small ground receiving antennas in the SHF band as well as relay narrow band signals in the UHF band.

Lewis also will design and build a power conditioning system for the Satellite project under the international agreement. Power conditioning is required to convert the electrical power from the solar arrays to both AC and DC current at proper voltages for operating the broadcast equipment. A Canadian power conditioning system will be used for two ion engines for station keeping and for other electrical systems on the spacecraft.

The technology satellite provides Lewis with an opportunity to flight test its high power tube under development since 1967, for the first time; its successful operation represents an advance in the state-of-the-art in broadcast distribution technology.

Called a depressed collector tube, its high power and high efficiency are important attributes for communications satellites, according to Dr. Henry Kosmahl, Head of the Tube Development Section at Lewis. The tube's power output of up to 200 watts means the beam transmitted from the satellite to earth will be well defined, permitting better reception.

(Continued on page 3)

Lewis tube...

(Continued from page 1)

The tube also will operate at more than 50% efficiency, which sharply contrasts with tubes in use today that have efficiencies of only 10 to 20%.

Dr. Kosmahl explains, "the efficiency of the tube is particularly important in space where energy is so expensive." It costs about $1 million for a solar array to furnish one kilowatt of electric power, Dr. Kosmahl says. A more efficient tube saves weight in a spacecraft because less power conversion equipment and thermal control surfaces (for radiating heat) are required.

What gives the new tube its superefficiency? Typically more than half of the energy streaming through an ordinary traveling wave tube is lost as heat, due to the basic inefficiency of the tube. However, the Lewis tube has a collector attached at the end of it to retrieve the excess energy and return it to the power supply to reuse. This device actually is a series of electrodes, resembling concave plates, that recover electrons of varying velocities. The collector not only sorts out the electrons by velocity, but also slows them down and prevents them from streaming back into the tube.

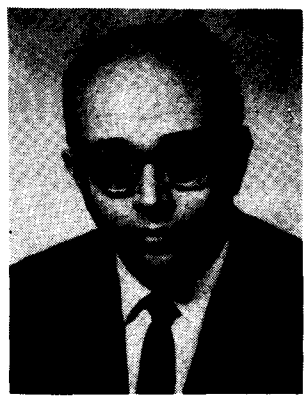
In addition to carrying the high power tube, the Communications Technology Satellite probably will carry a medium-power (20 watt) and low power (1 watt) tube. These tubes also will be employed for SHF signal amplification, and will also serve as back-ups should the high-power tube fail. The medium and low power tubes can only transmit to large ground receiving antennas.

During its two year life time, the satellite will relay television, audio and data signals from a stationary point some 22,300 miles above the earth, providing an extensive series of communications experiments of benefit to Canada and the U.S.

Lewis inventors:

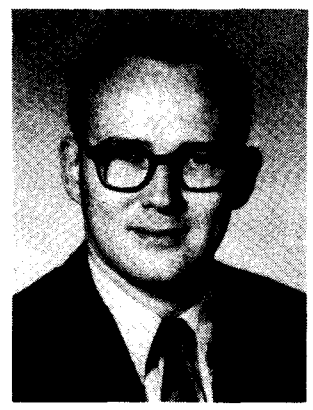
Invention Awards have been won by a number of Lewis employees during the past several months. Awards received from November 1971 through April 1972 are listed below. In an upcoming issue of the Lewis News more recent awards will be listed. Invention Awards are made under the provisions of the Government Incentive Awards Act.

Jacob D. Broder, an aerospace technologist in the Solar cell Branch, Energy Conversion & Materials Sciences Division, devised a method of binding cover glasses to solar cells. A thin film of a transparent plastic material is used as a binding material. This film is placed between the cover glass and the solar cell to form a laminate when heat and pressure are applied.



BRODER

Bruce A. Banks, an aerospace engineer in the Ion Physics Branch, Spacecraft Technology Division, invented an electromagnetic flow rate meter. The speed of a flowing liquid metal is measured by passing it through a magnetic field and measuring the resulting eddy currents with an ammeter. The current induced in the liquid metal by passing it through the magnetic field is directly related to the flow rate.



BANKS

A method for fabricating hollow balls and rollers for rolling element bearings has been developed. Using this method, preformed components are diffusion welded by heating in a vacuum furnace under a light pressure. With this process no microdeformation is involved in the welding process, and no foreign material is introduced into the joint. Thomas J. Moore, a materials engineer in the Materials Applications Branch, Materials & Structures Division, developed the method.

MOORE

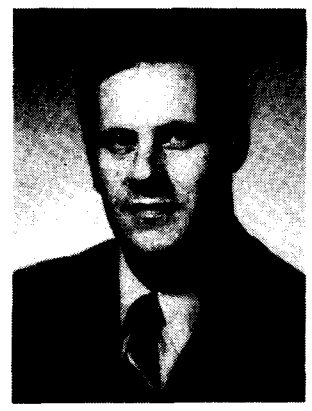
Richard J. Parker has developed a method for building improved bearings using low mass rolling elements which have high fatigue strength. Parker's bearings would use either hollow core rolling elements or solid but lightweight cores and be iron plated. An advantage of these bearings is the lighter weight of the balls and the longer life due to the lower centrifugal force on the outer race of the bearing. Parker is a materials engineer in the Bearings and Mechanical Power Transfer Branch, Fluid System Components Division.

PARKER

Aerospace technologist James A. Burkhardt developed a method for improving the performance of a magneto-plasma-dynamic (MPD) arc thruster in the 600 to 2100 seconds specific impulse range by mounting a hollow cathode in the exhaust beam. This type of thruster is potentially useful for satellite station keeping and altitude control missions. Burkhardt is a member of the Advanced Concepts Branch, Nuclear Systems Division.

BURKHARDT

DR. SERAFINI



DELVIGS

Dr. Tito Serafini and Peter Delvigs, two members of the Structural Mechanics & Polymers Branch, Materials & Structures Division, received an award for their "Preparation of Polymides from Mixtures of Monmeric Diamines and Esters of Polycarboxylic Acids." High molecular weight polyimides are prepared by mixing a diester of an aromatic tetracarboxylic acid, an aromatic diamine, and a monoester of a dicarboxylic acid in an organic solvent. The mixture is then polymerized after which it is cured at a temperature of from about 275°C to 350°C. Dr. Serafini is Head of the Polymer Matrix Composite Section and Delvigs is an aerospace technologist.

WEBER

FRANCISCUS

A supersonic combustion rocket engine has been invented by Richard J. Weber, Chief of the Mission Analysis Branch, Wind Tunnel and Flight Division, and Leo C. Franciscus, an aerospace engineer in that branch. The engine eliminates the heavy turbomachinery presently used for liquid rocket engines. Weber and Franciscus used the exhaust of similar rocket motors to create a pressure differential between the fuel and oxidizer tanks and a mixing chamber to "pump" the propellants. The exhaust gases from the smaller rocket motor are also used to carry along the fuel oxidizer mixture and speed it up to supersonic speed. Two important advantages to the system, according to the inventors, was the significant reduction in weight gain from removing the turbopumps and increased specific impulse resulting from igniting the propellants flowing at supersonic speeds.

Finding better, simpler methods

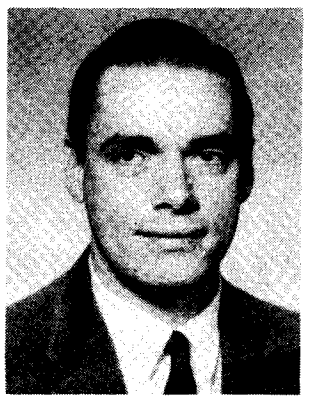
A hybrid bearing with substantially increased fatigue life for ultra high speed operation in a gas turbine engine, turbo pumps, and compressors has been invented. It was developed by William J. Anderson, Chief of the Bearings & Mechanical Power Transfer Branch, Fluid System Components Division. A fluid film bearing and a rolling element bearing are connected in a series which enables both bearing elements to support a fraction of a rotational load of a high speed shaft.

ANDERSON

Harold Gold, Head, Low Cost Engine Project Office, Airbreathing Engines Division, developed a gas turbine engine fuel control. This is a fuel control system which supplies the proper amount of fuel to a turbine engine to obtain the best fuel-air ratio for acceleration, deceleration or cruising. It comprises a network of variable orifices connected between a fuel pump and the engine. Some of the orifices are in series with one another and some are parallel. The orifices are appropriately controlled by devices which sense engine compressor inlet and outlet pressures, engine temperature and engine speed.

GOLD

An improved fuel system for thermal nuclear reactors has been invented by John L. Power. The system uses an inorganic ion exchanger to retain nuclear fuel in the reactor core. Continuous operation and constant reactivity is achieved by continuously inserting fresh fuel and removing spent fuel, thereby maintaining a constant fuel burn-up level. Also the fission products are continuously removed from the core volume, and the power density-profiles are optimized throughout the core volume. Power is an aerospace engineer in the Ion Physics Branch, Spacecraft Technology Division.

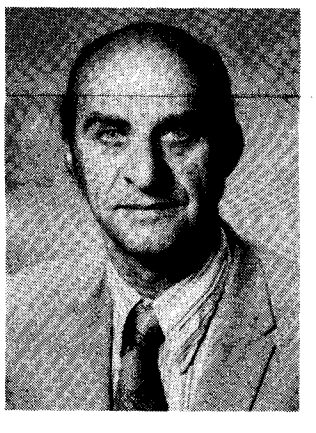


POWER

GRISAFFE

Salvatore J. Grisaffe developed a method for a coating used to protect low alloy austenitic stainless steels from damage at the high temperatures encountered in thermal reactors in automotive exhaust systems. The coating is made up essentially of a chromium containing nickel aluminide intermetallic compound as opposed to other coatings employed which generally consist of alloys. Grisaffe is Chief of the Surface Protection Branch, Materials & Structures Division.

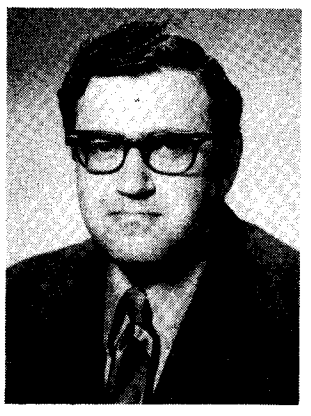
Dr. Henry G. Kosmahl developed an electrostatic collector for charged particles. The high efficiency collector for spent electron or ion beams comprises a stack of disked metal plates, each with a hole at its center to allow passage of the electron beam except for the last plate which is shaped like a cone and has a spike pointing toward the beam source. The first plate is bowed toward the beam source and is part of an imaginary sphere. The other plates follow mathematical equations of respective equipotential surfaces as determined by the voltage on each plate of the collector. Dr. Kosmahl is Head of the Tube Development Section in the Special Projects Office, Spacecraft Technology Division.



DR. KOSMAHL

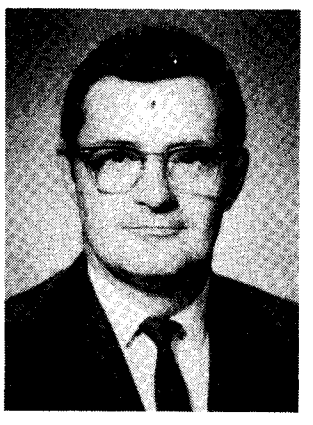
Microstructurally stable, high strength cobalt-base alloys for use at elevated temperatures up to 2125°F for stators and other low stress components in advanced gas turbines has been developed. The alloy has improved ductility after exposure at intermediate temperature. Developers of this are John C. Freche, Assistant Chief of the Materials and Structures Division and Robert L. Dreshfield, an aerospace technologist in the Alloys Branch of that division.

FRECHE

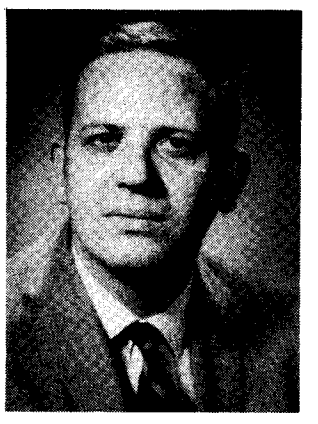


DRESHFIELD

Robert E. Jones and Richard W. Niedzwiecki have developed a combustor with improved performance for use in gas turbine engines. The invention is based on the use of swirl can modules which act as carburetors. Each swirl can module has a hollow cylindrical housing. Combustion air flows through the housing while fuel is sprayed in at right angles to the air flow. A swirling motion is imparted to the fuel air mixture by the fan type blades contained in a "swirl plate" at the outlet of the module. The fuel air mixture is ignited after it leaves the swirl can. The improved performance is a result of injecting premixed fuel and air. A full annulus combustor would have many swirl can modules mounted in concentric circles. For instance in a 42-inch diameter combustor, 120 swirl cans would be mounted in three concentric circles. Jones is Head of Combustion Section B, Combustion Branch, Airbreathing Engines Division and Niedzwiecki, a branch aerospace engineer.



JONES



NIEDZWIECKI

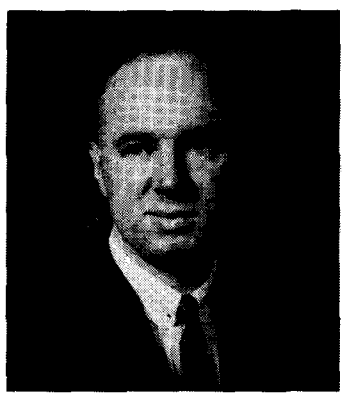
Staffers convert ideas into inventions, cash

Dr. Blue

Dr. Brown

Gray

Grisaffe



Luidens

Almost a dozen Lewis engineers and scientists were recognized through monetary awards for inventions developed by them in their area of expertise.

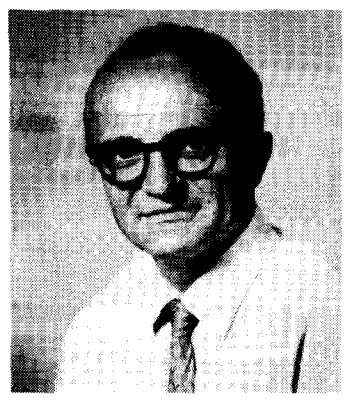
Bearings with improved stability and simplified damping solve the problem of the instability of lightly loaded shafts when they rotate at high speeds in bearings in low viscosity lubricants. The instability refers to a self-excited fractional-frequency "whirl" which is the tendency of the shaft center to orbit the bearing center at an angular velocity about half that of the shaft around its own center. The improved journal bearings are constructed without using expensive and complicated machining procedures. Each bearing is of fixed geometry and utilizes a plurality of sectors which provide lobed areas which function as a pump when the rotor turns. The resulting pressure distribution is similar to that obtained in a hydrostatic gas bearing. Developers of this are Frederick T. Schuller, a materials engineer in the Rolling Bearing Dynamics Section, Bearings & Mechanical Power Transfer Branch, Fluid Systems Components Division, and Warren A. Moore, a member of the Engine Research & Space Power Branch, Test Installations Division, until he left the Center in June.

John A. Woollam helped invent a "hall effect magnetometer." Bi_2Se_3 grown by the Bridgeman technique is utilized as the Hall-effect device in a magnetometer. Such a magnetometer has an output voltage linear to within one per cent for magnetic fields up to 10 Tesla and for a given constant temperature between 1.2K and 300 K. The Bi_2Se_3 has a rhombohedral crystal structure and a carrier concentration of between 10^{18} to 10^{20} per cubic centimeter. Woollam is a research physicist in the Cryophysics Section, Magnetics & Cryophysics Branch, Physical Science Division.

Three members of the Physical Science Division developed a method of making superconductor wire. The process involves forming at least one longitudinal groove in the surface of a wire comprised of a non-superconducting material. The wire is then twisted about its longitudinal axis to form the groove into a helix. Superconducting material is then deposited in the groove by vapor deposition or diffusion techniques. Developers are James C. Laurence, retired Chief, Magnetics & Cryophysics Branch; Willard D. Coles, Head, Magnetics Section; and Gerald V. Brown, Head, Cryophysics Section.

Roger W. Luidens, Chief, V/STOL Propulsion Technology Branch, V/STOL and Noise Division, developed a "Multiple Fan Integrated Propulsion Wing System." A row of fans powered by compressed air are positioned along the span of each wing. Their exhausts are deflected downward at the trailing edge of the wing to achieve high lift. Two or more turbo air pumps are also located on the airplane and compressed air is ducted from each air pump to all of the fans. With this arrangement, all the fans receive compressed air as long as one air pump is operative, thereby keeping the airplane balanced, even if the engine fails.

Three members of the Materials Science Branch, Energy Conversion & Materials Science Division, have developed a radiation chemical process for depositing high purity elements, particularly metals. The process can be used for separating desired metals from solutions containing several metal compounds. Aqueous solutions or suspensions of metal salts or compounds are irradiated with high energy particles. This promotes a chemical reaction causing metals to precipitate or separate out of the solution. The reaction mechanism involves a decomposition of the solvent by ionizing radiation. In aqueous systems the species formed are hydrogen atoms, hydrated (solvated) electrons, and hydroxyl radicals. The hydrogen atoms and hydrated electrons are reducing agents while the hydroxyl radicals are oxidizing agents. A metal can be reduced by the hydrogen atoms or hydrated electrons. The process is performed at room temperature, normal pressure, and under an inert atmosphere. Developers of this are Charles E. May, Head, Chemical Physics Section, Materials Science Branch; Warren J. Philipp, an aerospace technologist, and Stanley J. Marsik, a nuclear engineer, both in that section.



Marsik

Two members of the Materials & Structures Division, James L. Smialek and Salvatore J. Grisaffe, developed a method for making aluminized nickel coating for nickel-base superalloys. Using this invention nickel-base superalloys are coated to resist high temperature oxidation, corrosion and erosion. A nickel-rich layer is deposited and sintered to the substrate before aluminizing to form the intermetallic compound NiAL. The aluminide is formed by conversion of this nickel-rich layer only. This minimizes the amount of unwanted elements or phases present in the coating. The substrate is enriched in nickel during sintering of the nickel coating. This method prevents the formation of the nickel-depleted carbide zone as well as the sigma phase which is present in conventional aluminide coatings formed by outward diffusion of nickel, Grisaffe is Chief of the Surface Protection Branch, and Smialek is a materials engineer in the Branch.

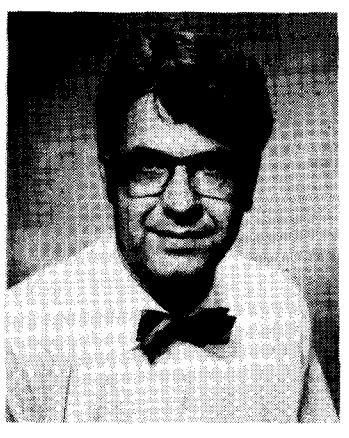
A concept for a space vehicle with an earth-like atmosphere, a tapered or bullet-shaped rotating cylinder and transparent at its large end to obtain heat and light from a nonrotating mirror directed toward the Sun, has been developed by Vernon H. Gray. Vapors produced in the vehicle are condensed at the cold end and, because of rotational forces, travel back along the inner surface of the vehicle to its large end. Annular lourves at the large end control the amount of heat and light admitted to the vehicle. Gray is Head of Section A of the Jet Acoustics Branch, V/STOL and Noise Division.

Thomas J. Moore, until he recently left Lewis, was a member of the Materials Processing & Joining Section, Materials Application Branch, Materials & Structures Division. He helped invent a method of solid state welding in air without deformation. The procedure can be used with thick sections and utilizes temperatures well below the welding temperature of the material welded. Surfaces of the parts to be welded are ground and cleaned. The surfaces are then brought together at a butt joint. This joint is first tack welded and then seam welded around the periphery of the butt joint. The tightly joined surfaces are cleaned by the use of an autogeneous or self-generated surface cleaning principal. This is designated as auto-vac cleaning and is used to reduce the effects of surface oxides that would normally hinder diffusion welding. Diffusion welding is obtained by heating the assembly in air with deadweight loading. The method does not require conventional vacuum hot-press equipment.

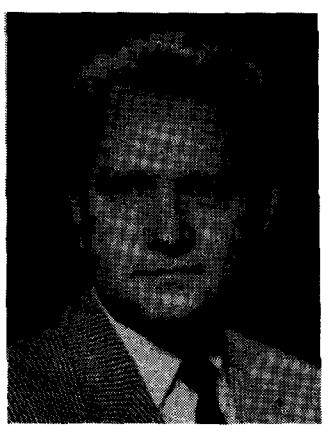
Henry G. Kosmahl, formerly Head, Tube Development Section, Special Projects Office, Spacecraft, Technology Division, has invented an "electron beam controller." This is an apparatus for refocusing a spent electron beam before it is injected into the collector producing increased efficiency in a microwave tube. The apparatus comprises a solenoid disposed around the axis of the spent beam between the interaction region of the tube and the collector. The length of the solenoid is from about 1/2 to 1 cyclotron wavelength while the distance between the interaction region and solenoid is from about 1 to about 3 cyclotron wavelengths. Kosmahl has left Lewis.

(Dr. Blue's writeup will be featured in the August 24 issue)

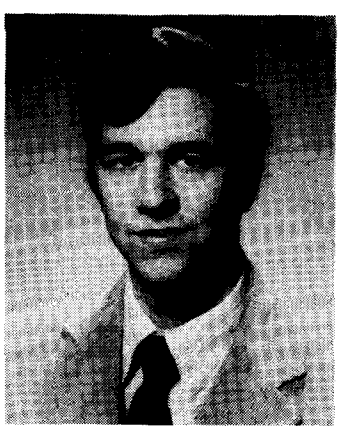
Dr. May



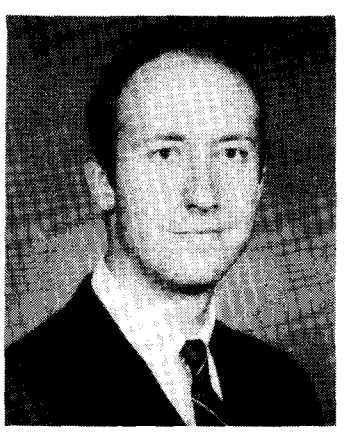
Dr. Philipp



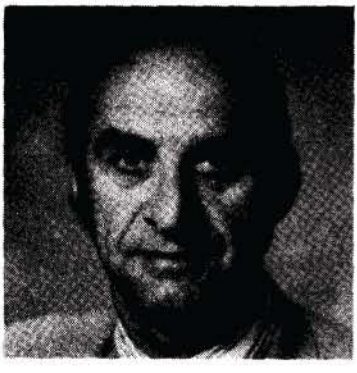
Schuller



Smialek



Dr. Woollam



Dr. Kosmahl

Coles

Dr. Kosmahl, Coles among lab inventors

Dr. Henry G. Kosmahl, Head, Power Amplifiers Section, Communication Technology Branch, Spacecraft Technology Division, has invented an "electron beam controller."

This is an apparatus for refocusing a spent electron beam before it is injected into a depressed collector; this refocusing produces increased efficiency in a microwave tube. It comprises a solenoid, or preferably an assembly of permanent magnets disposed around the axis of the spent beam between the interaction region of the tube and the collector.

The total refocusing field consists of a decoying field region and a more or less constant magnitude field stabilization region. Their respective lengths are from one to three cyclotron wavelengths and from one-half to one wavelength.

In addition to the U.S. patent application, the invention also has been filed in eight foreign countries. It will be flown on the CTS spacecraft together with the multi-stage collector, and is being applied to the USAF-EC systems.

"The invention helped substantially to establish record efficiencies in advanced traveling wave tubes," Dr. Kosmahl stated.

An invention using a heat pipe in the production of radioisotopes from very intense particle accelerators has been developed by James W. Blue, Head, Radiation Applications Office, Physical Science Division. The novelty in this invention is the combined use of cesium as the working fluid of the heat pipe and as the target material for the nuclear reactions. A beam of high energy protons or similar nuclear particles penetrates the wall of the heat pipe — and strikes the cesium causing a spallation reaction. This produces ^{123}Xe as well as radioactive contanminants. The beam deposits energy in the cesium and heats it to the point where it vaporizes. The vapor travels to the cool end of the chamber. The cesium condenses while the ^{123}Xe and other volatile contanminants pass through a porous metal plug to a dry ice trap. The radioactive contaminants condense in this cold trap while the ^{123}Xe passes to a liquid nitrogen trap. The ^{123}Xe condenses in the second trap and is held there for a period of time sufficient for it to decay to ^{123}I.

A combined Lewis-Public Health Service effort has shown the ^{123}I should replace ^{131}I for diagnostic studies of thyroid and other disease when it becomes available.

The story on Coles' invention regarding a method of making superconductor wire appeared in the August 10 issue of the *Lewis News*.

AF applies amplifier methods

A program aimed at improving the efficiency of the Air Force electronic counter measures (ECM) microwave tubes by applying methods developed here for space microwave amplifiers has been launched in a joint effort here by Lewis and the U.S. Air Force.

ECM's are electronic jamming devices which counteract such things as radar, and missiles, and are flown on thousands of AF aircraft.

The scope of the four-year program will be to apply the efficiency enhancement technology of microwave tubes developed at Lewis to a series of AF tubes having a various operating frequencies, bandwidth, and power levels.

"We believe that the adaptation of Lewis technology will permit the AF to substantially increase the jamming power without increasing the primary DC power," explains Dr. Henry G. Kosmahl who will direct the overall analytical evaluation of the program. Dr. Kosmahl heads the Power Amplifier Section of the Spacecraft Technology Division. Assisting him are Oliver Reese and Norbert Stankiewicz.

Lt. Col. Robert J. Erhart of the Aeronautical Systems Division at Wright-Patterson Air Force Base in Dayton is Project Manager, assisted by Project Engineer Donald E. Laycock. Liaison work between Lewis and the Air Force will be directed by Lt. Col. Harry Staubs who heads the Lewis-based Air Force Systems Command Liaison Office.

The project manager of this cooperative program is Peter Ramins.

"Lewis was selected by the Air Force to do the work out of several laboratories throughout the country because of achieved record in efficiency improvements in microwave amplifiers," Dr. Kosmahl stated.

NASA-Air Force team members include (standing, left to right): Dr. A. S. Gilmour, Jr., State University of New York at Buffalo; Dr. Henry G. Kosmahl, Thomas A. Fox, Arthur N. Curren, Ben T. Ebihara, and Francis E. Kavanagh, all of Lewis; (seated, left to right): Donald E. Laycock, Wright-Patterson Air Force Base; Lt. Col. Harry L. Staubs, NASA-AF Liaison Officer; Lt. Col. Robert J. Erhart, Wright-Patterson Air Force Base, and Robert E. Alexovich, Chief of the Lewis Communications Technology Branch, Spacecraft Technology Division. (Donald Huebler photo)

The project manager of this cooperative

Lewis Center develops new TV supertube

A radio and television signal amplifying tube, more efficient and powerful than any used in space today, has been developed here for use in a cooperative U.S.-Canadian satellite program to send programs to remoteo areas.

It was put together by Henry Kosmahl and his coworkers at NASA's Lewis Research Center in an effort begun in 1967.

Most other amplifying tubes are only 10% to 20% efficient. But the new tube is more than 50% efficient, according to Kosmahl.

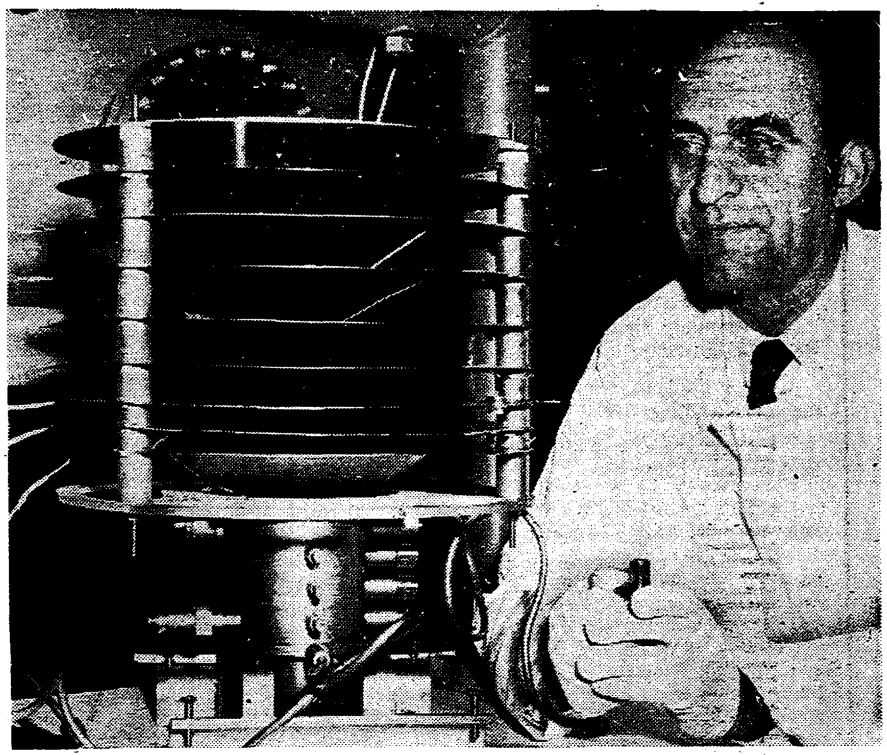
The tube puts out 200 watts. This means its beam back to earth will be well defined, permitting better reception.

The tube and its supporting apparatus will send programs to out-of-the-way places in Canada's north and to Alaska.

The tube is to be powered by solar energy. It will operate in the superhigh frequency range, 12 GigaHertz, or 12 billion cycles per second, an area not on most radio dials.

This will necessitate some rearranging of the standard TV set's insides so it can respond to the high frequency impulses.

NASA will bear the expense of the launching vehicle and the United States will have use of the satellite, to be called CTSo (Communications Technology Satellite). Canada willo pay for everything else.o



This array of highly polished plates is the newest, best and most powerful radio and television signal amplifying tube in the world. Next year it will hover over Canada in a satellite. Henry Kosmahl and his coworkers at NASA's Lewis Research Center here, put it together.

NASA upgrades missile jammers

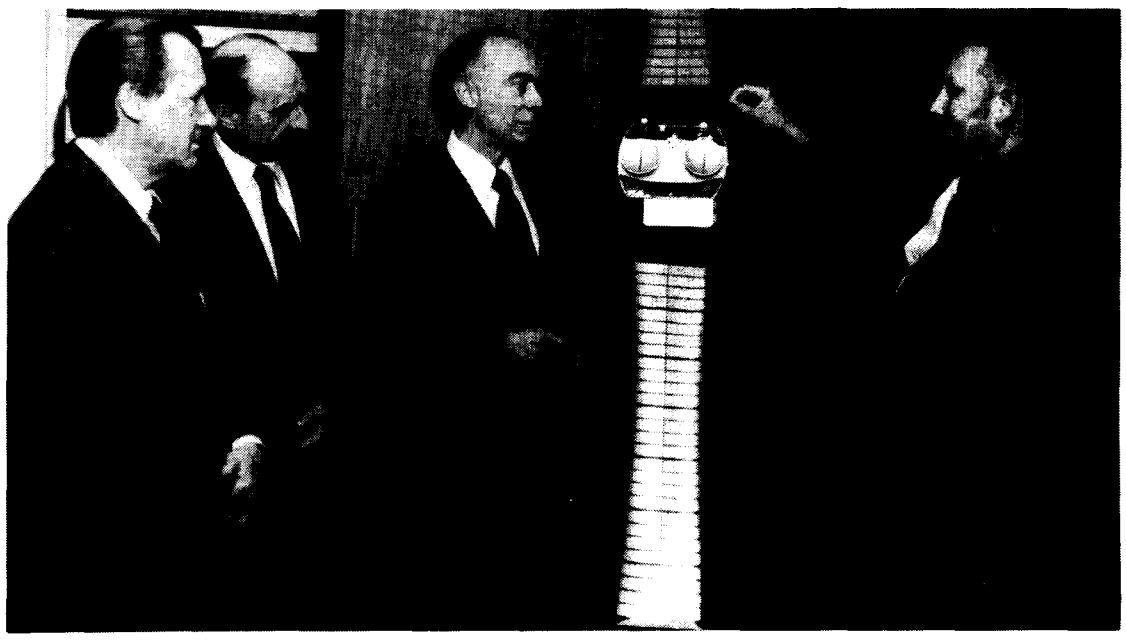
Electronic jamming devices to counteract enemy radar and missiles will be much improved as the result of work done here at NASA's Lewis Research Center.

The Air Force and the research center have begun a joint four-year program for applying space microwave amplifiers already developed here to permit the Air Force to substantially increase its jamming power.

An important factor concerns the creation of an amplifying tube by Henry Kosmahl and coworkers at Lewis for a U.S.-Canadian communications satellite. The tube operates at 50% or more efficiency in contrast to other tubes, which are only 10% to 12% efficient.

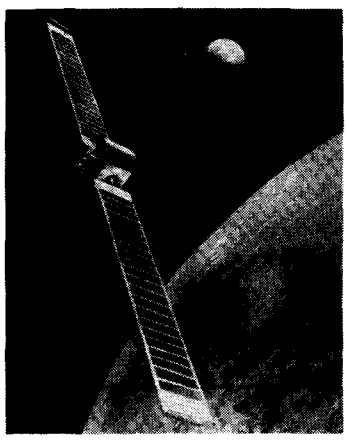
THE PLAIN DEALER, SATURDAY, JUNE 1, 1974

They developed the transmitter for CTS —



Left to right: Elmer H. Davidson, Dr. Henry G. Kosmahl and H. Warren Plohr listen as Robert E. Alexovich, principal investigator for the TEP experiment, explains features of the CTS radio frequency system.

Left to right: William F. Loftus and Sco console as Joseph L. Fiala examines proce



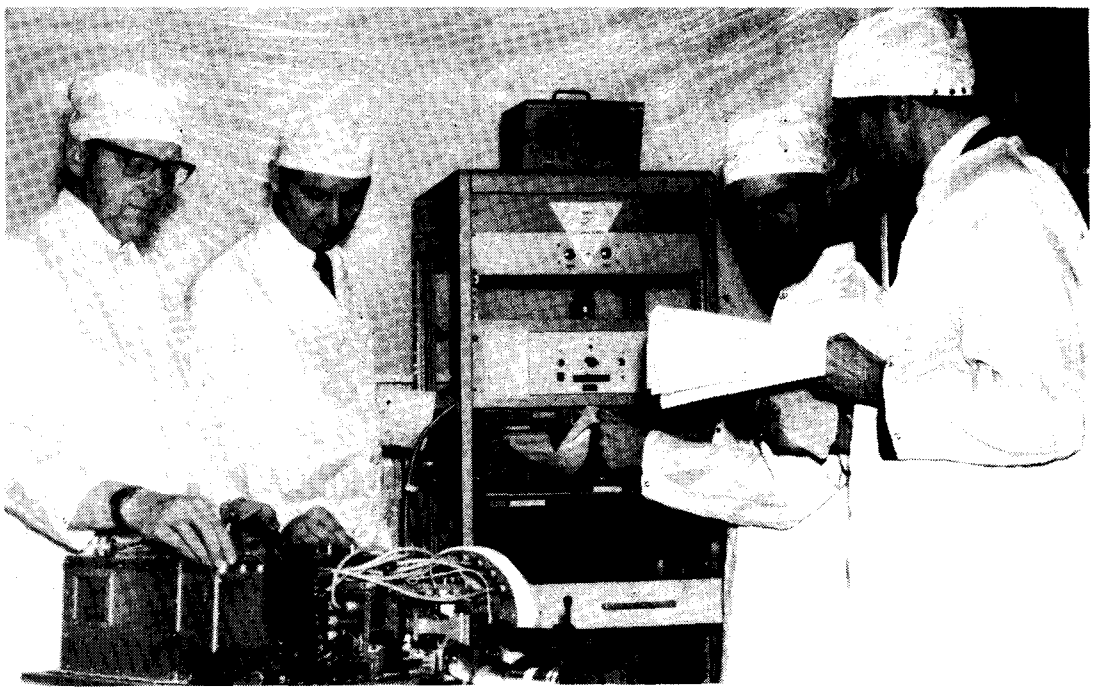
Left to right: Gerald J. Chomos goes over details of high power tube construction with James DePauw and Arthur M. Curren.

A team of 40 persons drawn from the Spacecraft Technology and Test Installations Division recently completed nine day of around-the-clock in-orbit testing of the 200-watt Transmitter Experiment Package (TEP) aboard the Communications Technology Satellite spacecraft.

The spacecraft was launched January 17.

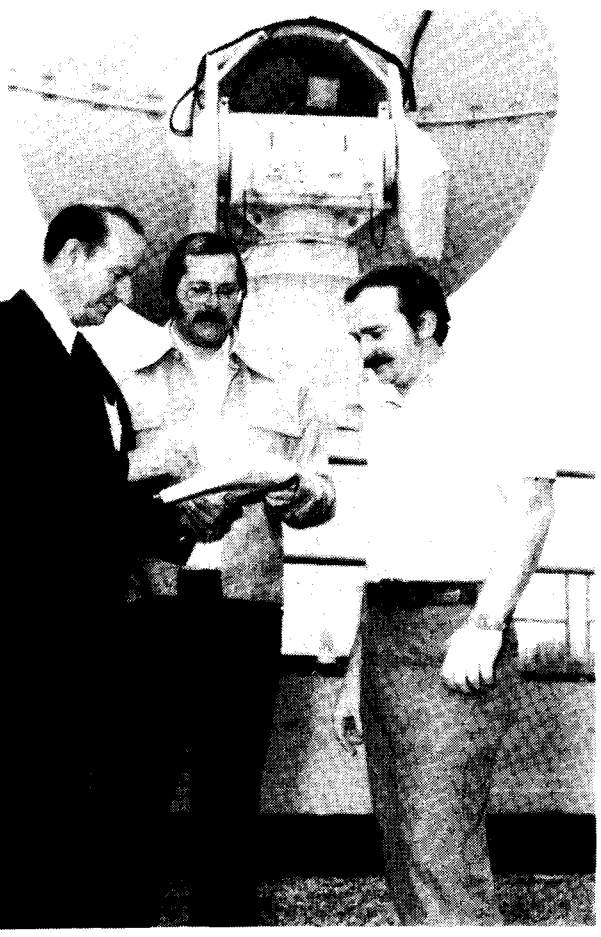
The first series of evaluations demonstrated that the TEP, the high power radio frequency transmitter for the spacecraft, performed according to ground tests.

The TEP consists of two major subassemblies, the output stage tube and the power processing system and is the highest powered transmitter in space with broadcast power 10 times that of operational space communications



Clifford E. Siegert (left) and Karl F. Reader check connections to TEP package while John V. Staskus and Richard W. Vasicek review data from life test.

Photos by Don Huebler



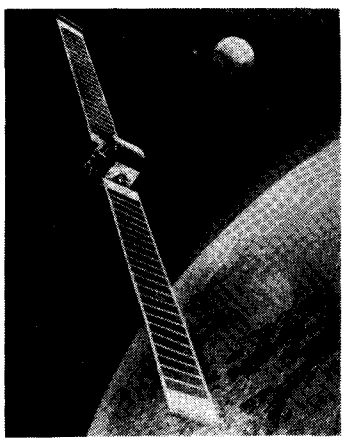
Left to right: Royce W. Myhre, David D. Renz and John J. Ropchock check performance of antenna used for tracking CTS spacecraft.

now they monitor its performance in space

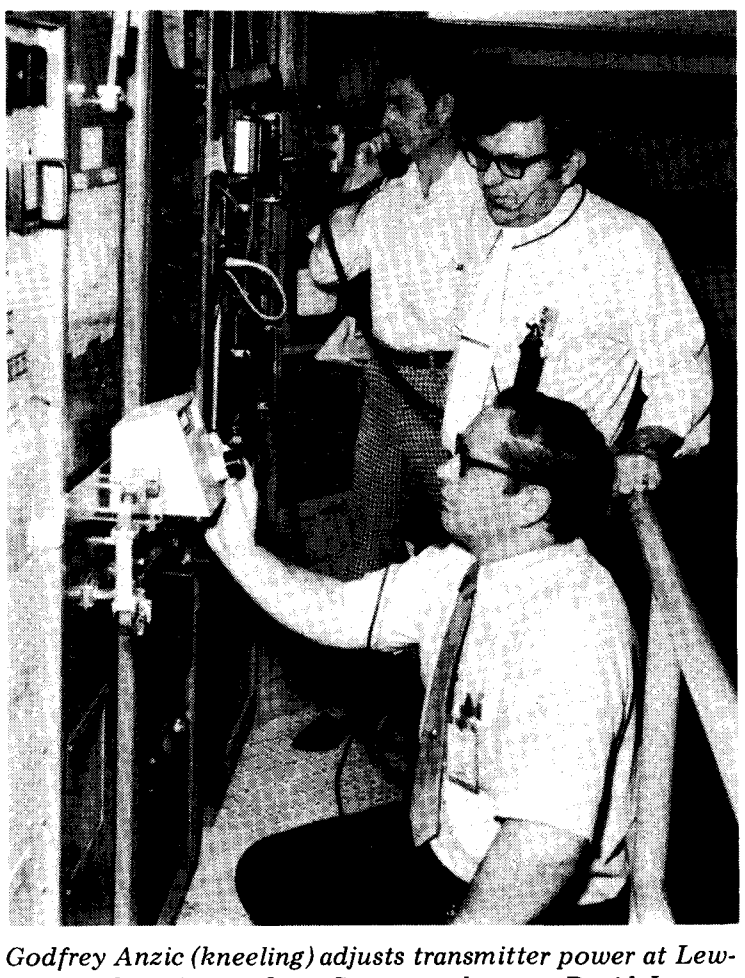
Barnes conduct TEP experiment at control
s brought by Marjorie E. Edwards.

Michael D. Richardson (standing) and Dr. Edward F. Miller observe TV monitor as James F. Travis makes adjustments.

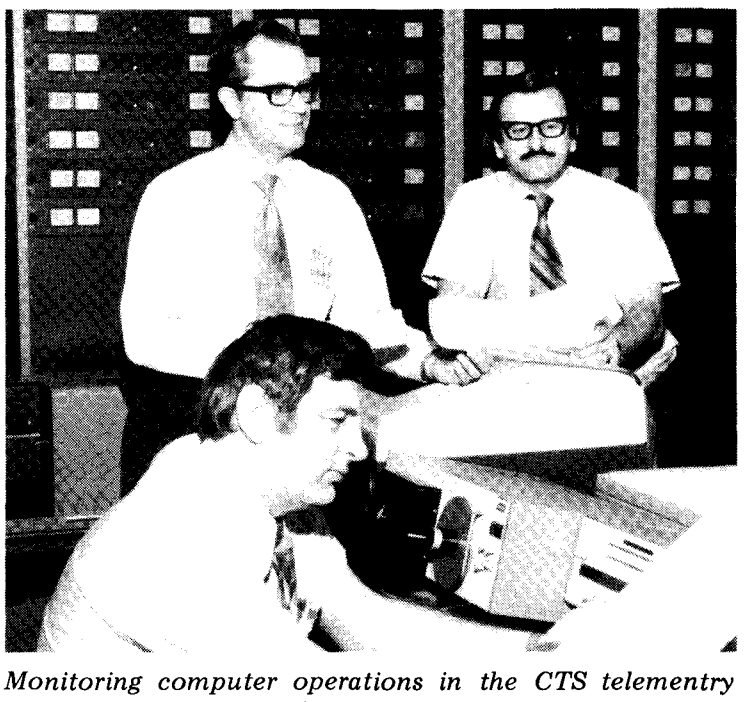
Paul R. Auerhamer (left), George R. Smolak and Louis Gedeon review TEP thermal data.



Monitoring CTS spacecraft operations are test conductors (left to right) Richard J. Krawczyk, Louis R. Ignaczak, Joseph A. Hemminger, Robert J. Zakrajsek and Mark R. McCrae.



Godfrey Anzic (kneeling) adjusts transmitter power at Lewis ground station as Jerry Smetana observes. David Jurgens relays power reading to control center.



Monitoring computer operations in the CTS telementry center are (left to right) Bruce G. Lindow, James W. Bagwell and Edward J. Petrik.

items.
The team will evaluate the TEP riodically during the two-year pected space life of CTS to a- ieve the following experiment jectives:

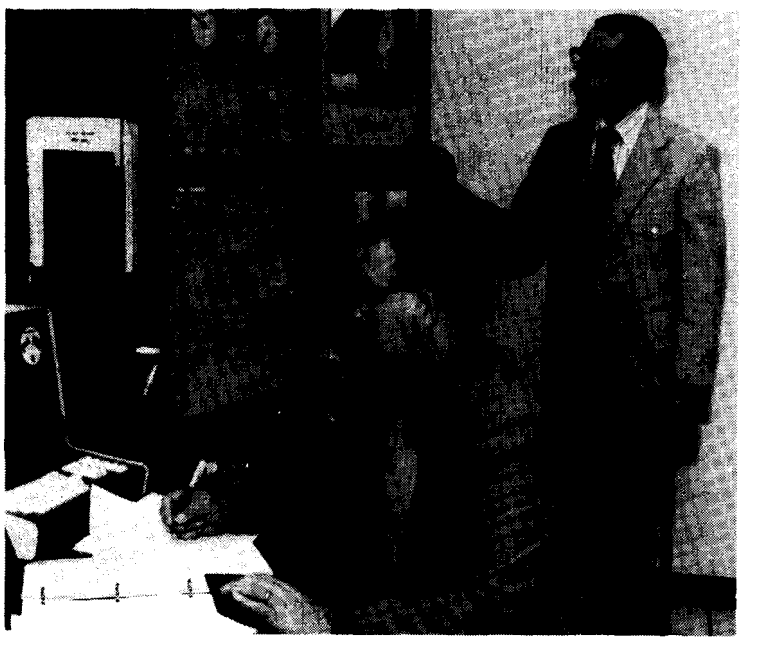
- To demonstrate in space an plifier operating with an ef- iency greater than 40 percent d a saturated radio frequency tput power greater than 180 tts at a frequency of 12 gigartz.
- To demonstrate reliable, h efficiency performance for e transmitter experiment packe for two years in a space enonment;
- And to obtain fundamental ta for further advancement in e state-of-the-art of high power crowave amplifier operations space.

The CTS project, a joint effort of Canada and the U.S., began in 1971. The U.S. provided the launch vehicle, the TEP, and test support during the spacecraft development. Canada developed the spacecraft and is operating it in orbit. Joint experiment time is shared equally between the two countries. The joint venture promises relatively low cost color TV reception to communities throughout Canada, Alaska and the Rocky Mountain states.

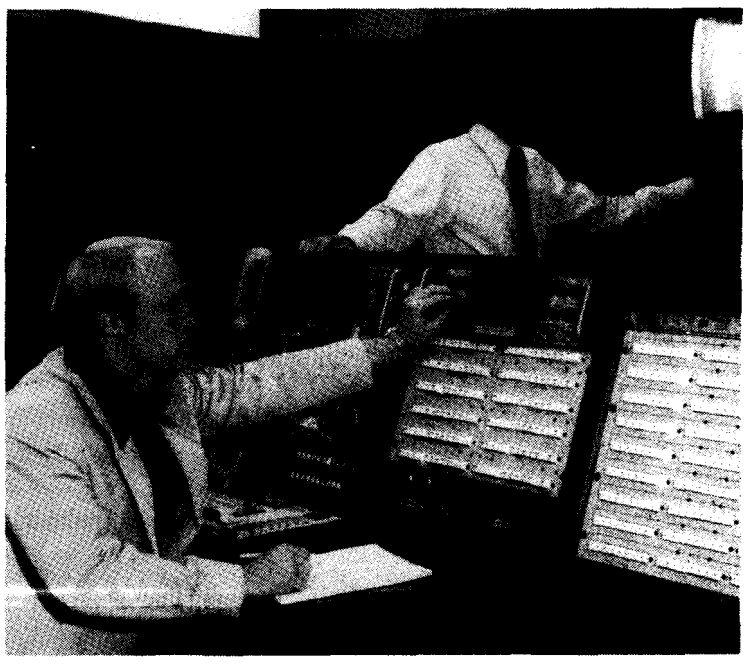
"Satisfactory operation of the TEP has shown that the CTS spacecraft is ready and able to support the experiments by the U.S. and Canada during its life in space," predicted Dr. Edward F. Miller, who led the in-house evaluation tests of the TEP.

Better communications through...

Branch Chief Robert E. Alexovich (left), Dr. Henry G. Kosmahl and Dr. Edward F. Miller discuss new and on-going programs while secretary Marjorie E. Edwards reviews notes.



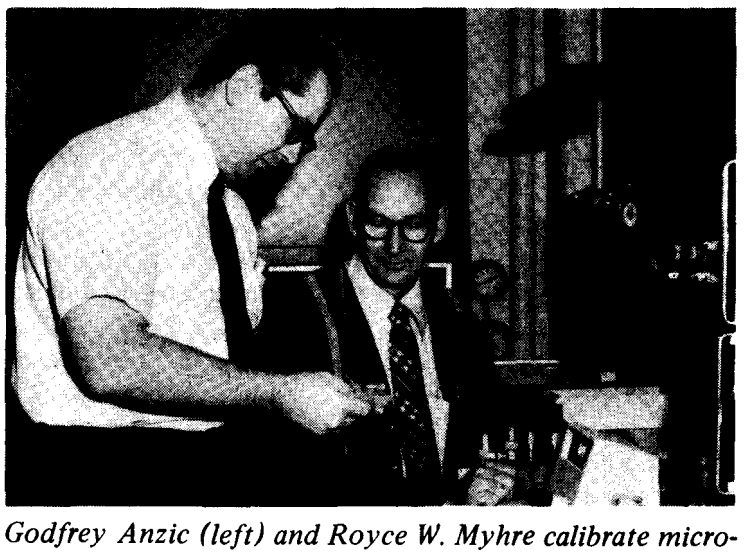
Arthur N. Curren (seated) examines spacecraft telemetry while Thomas A. O'Malley checks antenna position.



Michael D. Richardson (left) and Scott P. Barnes evaluate video system for International Radio Consulting Committee study.

Dr. James A. Dayton, Jr. inspects scattering chamber for laser light diagnostics of electron beams.

Dr. Denis J. Connolly (left) and Frank E. Kavanagh perform cold test measurements on tube components.



Godfrey Anzic (left) and Royce W. Myhre calibrate microwave equipment.

...technology!

The Communications Technology Branch, where nearly one-third of the staff holds Ph.D. degrees, can also boast of being the prime Lewis group involved in on-going research in communications technology.

The branch is headed by Robert E. Alexovich and performs research and development of high power satellite communications systems, microwave power transmission from space and related technology for both terrestrial and space applications.

Current projects include support of the Communications Technology Satellite (CTS) program, developing high efficiency collectors for an electronic countermeasures program and other programs.

The branch's Power Amplifier Section, headed by Dr. Henry G. Kosmahl, develops high efficiency microwave tubes which form the basis of the newest high power communications satellites. Section members work on matrix cathodes, operating them at high current densities to understand the mechanisms of operation and determine how to increase their life. In addition, the Section performs work on advanced cathodes, using field emission from an array of 5000 points in an area the size of the period at the end of this sentence.

This Section also is in the process of investigating high power amplifiers for potential use in a solar power station that would transmit energy via microwaves to a large receiving antenna system," Alexovich said, adding, "These technologies may be required by NASA around the turn of the century."

The Systems Engineering Section, headed by Dr. Edward F. Miller, develops applications of high power communications technology using satellites, and evaluates devices for their suitability to perform required communications functions. To achieve these objectives, the section performs analyses and measurements of communications systems for transmission of signals such as video, audio, and high and low speed digital data.

For the CTS program, the section's tasks range from evaluating engineering model tube performance with a single unmodulated carrier to evaluating the spacecraft communications transponder in orbit with multiple video signals. A study is underway on how best to develop the 40 and 80 GHz frequency bands for space broadcast. The emphasis of the sections work is currently shifting from analog (continuous) signal processing to digital (non-continuous) processing. Frequency sharing techniques between analog and digital television systems are being developed to assist in international planning on the use of the frequency spectrum.

Norbert Stankiewicz (left) and Thomas A. Fox confer on testing the Air Force's electronic counter measure tube.

Photos by Martin Brown

Scientists hear Kosmahl

Dr. Henry G. Kosmahl, Head, Power Amplifier Section, recently made a two-hour presentation to some 50 scientists and engineers at Hughes Electron Dynamics Division, Torrance California.

Dr. Kosmahl spoke on "High Efficiency Electron Tube Work at Lewis."

In requesting Dr. Kosmahl's appearance, Hughes Electron Dynamics Division Managers wrote, "We would be most appreciative to have Dr. Kosmahl address our technical staff on the subject of Traveling Wave Tube Efficiency Improvements. We are convinced that the technical exchange that this would stimulate would provide benefits torboth our organizations."

The LEWIS NEWS presents the Lewis Research Center story in terms of its people, its purpose and its progress. Published on alternate Fridays, the News is produced by the Public Information Office, Lewis Research Center National Aeronautics and Space Administration, 21000 Brookpark Road, Cleveland, Ohio 44135.

News items should be phoned into PAX 3284, or sent to Room 120, Ad.Bldg., Mail Stop 3-11. Deadline is ten days prior to publication.

Editor ..... Charles Mitchell

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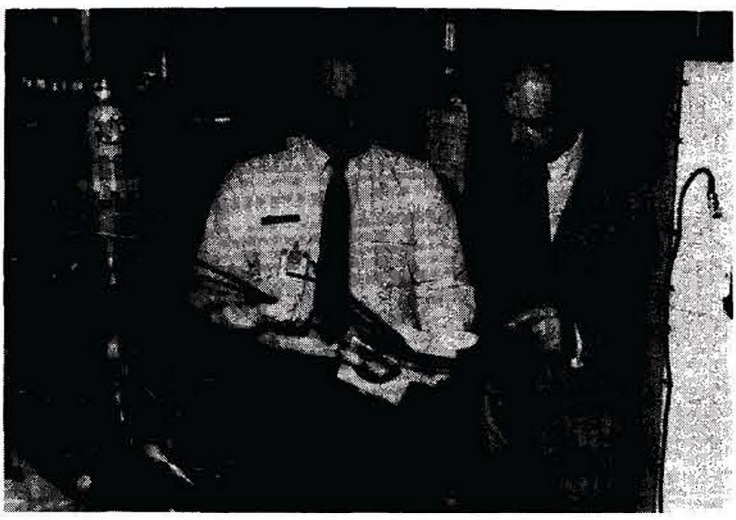


Air Force Major Erik Buck (left) and Dr. Henry G. Kosmahl review an experimental version of a multi-stage depressed collector developed by Lewis researchers. (Don Huebler photo)

Air Force eyes TWT

Lewis' collectors are depressed but the Air Force and Navy are elated!

With techniques known as multi-stage depressed collectors (MDC) and spent beam refocusing, both developed by Lewis experts Dr. Henry G. Kosmahl and Peter Ramins, better high power communications and radars are now possible.

Acknowledging the accomplishments of Lewis over recent years in traveling wave tubes (TWT), the Air Force and the Navy have concluded an extended agreement for joint involvement with Lewis that will extend work through 1980.

Lewis will continue analyses and experiments to improve TWT efficiency and performance. The Air Force will run a parallel TWT program which exploits the developments at Lewis, make manufacturing refinements and plan how best to use the new technology in advanced systems. The Navy's Weapon Support Center, Crane, Indiana, will furnish the TWT's along with extensive expertise.

Air Force and Navy attention is focused particularly on the tubes for the ALQ-99 electronic countermeasures system. The system is used on the new Air Force's EF-111 aircraft and the Navy's EA-6 aircraft. The EF-111 is the electronic version of the famous fighter bomber. As the Air Force's new stand-off jammer, the EF-111 is designed to protect friendly aircraft by jamming hostile radars and to provide a more powerful defense with fewer airplanes.

Air Force Major Erik Buck has been assigned to Lewis' Communications Technology Branch. He will act in a dual role as both an Air Force and NASA engineer. "I'll help uphold and expedite the Air Force's end of the interdependency agreement, plus be a part of the Lewis team of TWT experts. The Lewis team is regarded by key outsiders as the best anywhere," Major Buck said. He added, "Current conventional vintage TWT's key frequencies may have been operating at only 15 percent efficiency, putting out about two kilowatts of radio power for a power consumption of 14 kilowatts. This wasted energy must be dissipated as heat. The excess heat severely reduces the lifetime of both the tubes and the aircraft generators which must supply the power. Inefficient TWT's are power hogs which can't be tolerated on a cost basis, and would be inadequate for the more demanding defense missions of the future."

Multi-stage depressed collectors use several collectors, typically two or four, at a variety of negative (depressed) potentials to catch the electrons just as they have spent their energy. Leftover electron beam energy is a major source of wasted TWT energy.

"The trick is not to achieve the highest efficiencies. That has already been done with sophisticated designs. Fifty-six efficiency has been obtained with 9-stage multistage depressed collectors on the Communications Technology Satellite. The challenge is to achieve very high efficiencies with simple, practical low cost designs," Major Buck explained.

Spent beam refocusing keeps the electron beam narrow and reduces radial velocity spread (wasted energy), allowing more efficient smaller tubes. The refocusing acts along a length of the beam changing transverse (crosswise) velocities of the electrons, which would spread from the beam, into the axial, (rotational) motion.

According to Dr. Kosmahl, overall efficiencies of better than 40 percent appear reachable for high power wide band TWT's at important frequencies using the just described techniques.

Dr. Henry G. Kosmahl

Kosmahl receives IEEE's top honor

Dr. Henry G. Kosmahl, Head of the Power Amplifier Section of the Applications Division, was recently elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). The honor was given to Dr. Kosmahl for his "contributions to the theory of traveling-wave tubes and klystrons leading to increased efficiencies."

Although the citation might sound complicated, Dr. Kosmahl explained that his work was actually done on a converter of leftover kinetic energy. The energy,

(Continued on page 2)

Kosmahl...

(Continued from page 1)

if allowed to escape, becomes useless heat. The converter changes this heat into potential energy which is returned to the power supply. Use of such a converter reduces the power consumption significantly and improves efficiency by a factor of 3 to 20 depending on conditions.

The converter has a wide application in the communications field. It is currently used on the Communications Technology Satellite as well as on military planes and ships. Dr. Kosmahl said the future possibilities of this technology are numerous.

Dr. Kosmahl has also received other honors for his work. In 1974 he was awarded the NASA Exceptional Scientific Achievement Medal. In 1977 he was jointly honored by the IEEE and the Department of Defense with a Technology Advancement Award. Dr. Kosmahl has worked at Lewis since 1962.

LEWIS NEWS

NASA
Lewis Research Center
Cleveland, Ohio

Vol. 17 No. 15 July 8, 1980

Center gives $15,000 award to inventor Kosmahl

Dr. Henry G. Kosmahl of NASA Lewis Research Center has received the highest monetary award ever granted a Lewis researcher for his invention leading to the development of the world's most efficient and powerful electronic tube for amplifying audio and video signals from space.

The $15,000 award was given to Dr. Kosmahl for his invention of the Depressed Collector Tube. He heads the Microwave Amplifier Section at the Lewis Center.

The tube operated at more than 50 percent efficiency on the Communications Technology Satellite. (CTS). The CTS was a joint venture between this country and Canada to transmit pictures from earth to the CTS 22,000 miles in space and then back to remote areas of this continent.

Unlike ordinary traveling wave tubes, which are relatively inefficient, Dr. Kosmahl's invention has a collector attached to the end of it to retrieve the excess energy and return it to the power supply for reuse. The device is a series of electrodes, resembling concave plates, that recover electrons of varying velocities just after they have spent their energy.

Deputy Director Dr. John M. Klineberg presents $15,000 check to Lewis inventor Dr. Henry G. Kosmahl. (Dan Laity photo)

The collector not only sorts out the electrons by velocity, but also slows them down and prevents them from streaming back into the tube. An example of the principle would be a series of conducting plates to catch water droplets coming from a fountain. When the droplets reach an apex, the role of the collector is to catch the droplets before they fall down.

Kosmahl's invention and its perfection by his coworkers was called "revolutionary" by his professional peers. It is being applied by the Department of Defense as part of its electronic warfare arsenal.

The German-born Lewis Center scientist holds 10 U.S. patents, six foreign patents and has three pending. In 1974, the NASA agency awarded him its highest science medal for his Depressed Collector Tube invention. Dr. Kosmahl also is a Fellow of the Institute of Electrical and Electronic Engineers and is listed in Who's Who in Science and Technology and American Men of Science. He delivered invited lectures at Stanford, Cornell, MIT and CWRU, published over 40 journal articles and co-authored two books.

Dr. Kosmahl lives in Olmsted Falls with his wife, Gisela. They are the parents of two daughters and a son.

The Plain Dealer
Saturday
July 19, 1980
Page 9-B

Lewis man wins again

NASA rewards Kosmahl for his power-saving tube

By Stephen A. Blossom

Dr. Henry G. Kosmahl, a research scientist at the NASA Lewis Research Center here, could be called a collector of awards.

His latest award (accompanied by a check rfor $15,000) is a certificate of recognitionr from NASA's Inventions and Contributionsr r Board "For the creative development of ar scientific contribution ... of significant value ... in aerospace technology ... the multistage-depressed-collector (MDC) Systemr Components."r

The device, more familiarly known as the Kosmahl Tube, can perform as a super radarr jammer in electronic warfare or as an effective power saver in communications satellites.r

Three years ago, the Department of Defense and the Institute of Electrical and Electronic Engineers jointly awarded Kosmahlr recognition for contributions to the theory and application of high-efficiency concepts inr electronics.

Three years before that, NASA awarded him its highest science medal for developing the tube in the first place.

He holds 10 U.S. patents and six foreign patents, is the author of two books and 40 rpapers and has lectured widely in the Unitedr States.r

In its commercial application, the importance of the Kosmahl Tube will be most evident in UHF-TV transmitters throughout ther United States. When these transmitters are inr operation, the tube is expected to save oner billion kilowatt-hours a year.r

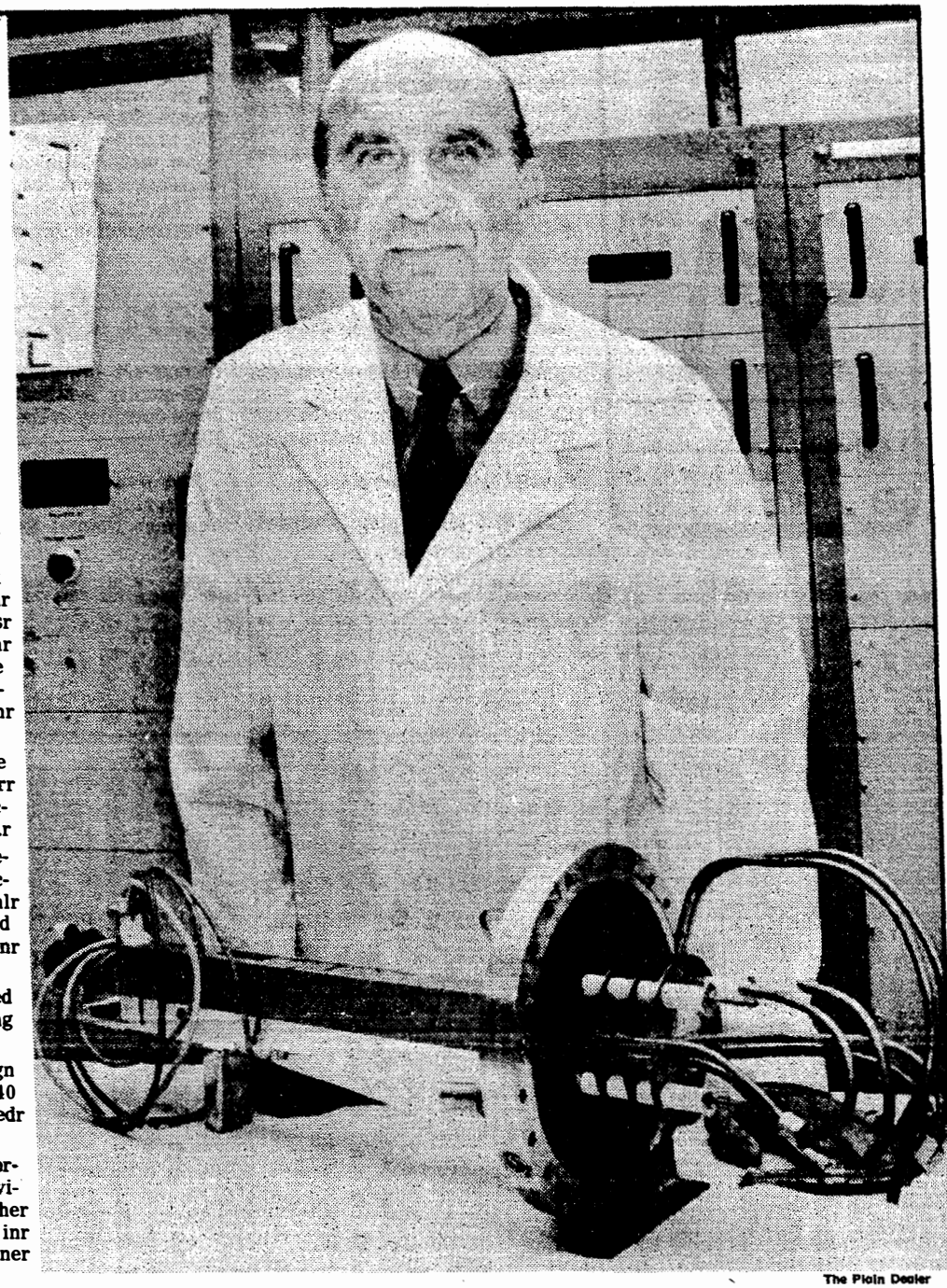
With energy becoming more expensiver every year, that's not peanuts.r

Kosmahl estimates that the tube willr boost a transmitter's efficiency from 15% tor 50% or 60% in many cases. In a communications satellite it reduces power consumption by a factor of one half to two thirds.

The tube operated for three years on an experimental basis aboard the Communication Technology Satellite, managed by Lewis.

The tube, about 3 feet long and weighing 10 pounds, costs about $16,000 installed aboard a military aircraft. In such applications, it can protect airplane squadrons against missiles and radar.

Kosmahl came to the United States in 1956, when the cold war was stirring fears of a conflict with Russia, and the United States was suffering from a shortage of scientists in those years. He joined NASA in 1962 and now lives in Olmsted Falls.



The Plain Dealer

Henry G. Kosmahl, inventor of a super radar jammer for the U.S. armed forces, displays his latest research project in an electronic laboratory at NASA's Lewis Research Center.

CWRU to hear Kosmahl's lecture

Dr. Henry G. Kosmahl of Lewis' Space Communications Division, Microwave Amplifier Section has been invited to deliver a lecture on "Electron Beam Devices Status and Trends" at a colloquium on January 14 at Case Western Reserve University.

Kosmahl

This marks his second presentation at CWRU. In 1979 he discussed the "use of travelling waves interacting with electron beams to amplify very high frequencies."

Essentially Kosmahl will conduct a review of progress across the entire spectrum of electron beam devices, emphasizing the importance of research into various means of achieving high frequency amplification.

Among these are the optical methods, including the laser beam. But as Kosmahl explains, "the laser has serious limitations in power and frequency. Electron amplification, for all practical purposes may extend to infinity. You can go higher and higher."

As lower frequencies are occupied by various applications, Kosmahl contends, communications require the creation of new frequencies not yet allocated or assigned. NASA's contribution to this effort involves the efficient generation of new waves as energy becomes more expensive.

NASA device could significantly reduce power needs of UHF TV stations

A compact radio wave amplifier invented by Dr. Henry G. Kosmahl of Lewis may benefit UHF television stations by reducing their electrical power requirements significantly.

This saving has potential advantages especially for the nation's non-commercial public television stations since the majority of them transmit on the UHF television band.

The device is a multi-stage depressed collector and was originally invented by Kosmahl to improve communications satellite efficiencies. The device is used to increase the intensity of the radio signals transmitted by communications satellites without

(Continued on page 2)

NASA reducing UHF power needs...

(Continued from page 1)

increasing their electric power consumption - a real benefit for solarcell-operated spacecraft. The device can also be used for terrestrial microwave or ultra high frequency (UHF) television transmissions.

A typical, large, 200,000-watt UHF television station in a medium to large metropolitan area requires about $300,000 worth of electricity per year to stay on the air.

Smaller stations servicing smaller markets require less power. By 1985, with expected fuel surcharge and inflation increases, the electric bill for all the nation's UHF broadcasters could reach $100 million.

The application of the multi-stage depressed collector to transmitter amplifier tubes now installed at UHF stations could reduce their electric consumption by as much as one-third to one-half. This could amount to a savings of some $45 million beginning in 1985. Installation and equipment charges for this device are expected to pay for themselves in one year.

UHF television stations presently use devices call klystrons to generate and amplify the ultra high frequency current, which is the broadcast signal. Klystrons are vacuum electronic tubes which operate at efficiencies of only about 10 to 15 percent. By modifying the klystrons to include the multi-stage depressed collector, efficiencies of up to 30 percent are achievable. These higher efficiencies reduce power consumption levels correspondingly.

Kosmahl estimates the cost of converting the multi-stage depressed collector to work with UHF transmitter klystrons would be about a million dollars and would involve a development program lasting about about three years. Following that effort, individual UHF stations could purchase klystrons with the efficiency-improving device directly from industry sources.

Kosmahl invented the device in 1969 and was awarded a U.S. patent in 1972. An experimental model of the electron beam device, fabricated by Litton Industries, was launched aboard the Communications Technology Satellite in 1976 for a three-and-one-half-year-long test managed by Lewis Research Center. During that period, it produced the most powerful radio signals ever transmitted from space and beamed broadcasts to smaller, low-cost antennas sited in remote areas of the United States, including Alaska, and Canada.

February 26, 1982

Lewis inventors in the limelight

Lewis Director Dr. John F. McCarthy Jr., will present awards to 21 Lewis inventors at the seventh annual Lewis Inventor's Day Ceremony on May 17.

The awards will bear an embossed replica of the first page of the inventors' respective patents. The ceremony will be held in the small dining room in the main cafeteria building.

The Lewis entry into the national inventor competition will be the patent given to Li-Chen Hsu, Dean W. Sheibley and Warren H. Philipp for their patent, "Polyvinyl Alcohol and Method of Making Same."

Other inventors to be honored at the ceremony are Robert C. Bill, Peter Delvigs, Philip E. Hodge, Charles A. Hoffman, John M. Kazaroff, Henry G. Kosmahl, Stanley R. Levine, Robert A. Miller, Norman W. Orth, Bernard L. Sater, Tito T. Serafini, Raymond D. Vannucci and John W. Weeton.

The plaque for patentee Lawrence P. Ludwig will be given to his widow.

Inventors also to be honored but not able to attend the presentation are Anthony Fortini, Izhak Etsion, Abraham Lipshitz and William J. Nagle.

Inventors of the year honored

Nineteen Lewis inventors have been honored with plaques carrying an embossed replica of the first page of their patents at the Seventh Annual Inventors Award ceremony held earlier this year.

Lewis Patent Counsel Norman T. Musial started the Inventors Award event at Lewis. It is now an official NASA-wide annual function.

The 19 honored this year and the titles of their inventions are as follows:

Peter Delvigs, Tito Serafini and Raymond Vannucci, "Curing Agent for Polyepoxides and Epoxy Resins and Composites Cured Therewith." Serafini and Delvigs also invented "Composition and Method for Making Polyimide Resin-Reinforced Fabric."

Bernard Sater invented a "Method of Cold Welding Using Ion Beam Technology."

Li-Chen Hsu, Dean Sheibley and Warren Philipp, "Cross-Linked Polyvinyl Alcohol and Method of Making Same."

Philip Hodge, Robert Miller and Stanley Levine, "Corrosion Resistant Thermal Barrier Coating."

Charles Hoffman, John Weeton, retired, and Norman Orth, "Method for Alleviating Thermal Stress Damage in Laminates."

Henry Kosmahl, "Multistage Depressed Collector for Dual Mode Operation."

Lawrence Ludwig, deceased, "Circumferential Shaft Seal."

Philipp, Hsu and Sheibley, "In-Situ Crosslinking of Polyvinyl Alcohol."

William Nagle, "Toroidal Cell and Battery."

Robert Bill and Ludwig, "Composite Seal for Turbomachinery."

Anthony Fortini, retired, and John Kazaroff, "Heat Exchanger and Method of Making."

Inventors of 1982 — continued top of page 6

Sater

Hsu

Hodge

Miller

Fortini
(Retired)

Kosmahl

Delvigs

Levine

Nagle

Hoffman

Kazaroff

"He that invents a machine augments the power of a man and the well-being of mankind."

H.W. Beecher

Ludwig
(Deceased)

Orth

Bill

NASA scientist clears airwaves

By Thomas W. Gerdel

Discoveries by a scientist at NASA's Lewis Research Center could help prevent a communications satellite jam-up in space.

Henry G. Kosmahl, an electron physicist, has found a way to improve the efficiency of a traveling wave tube, a key part of a satellite amplifier.

A satellite with the improved technology is expected to be launched in 1985, said Tom Appleby of Hughes Aircraft Co.'s Electron Dynamics division in Torrance, Calif., which builds the amplifiers. Kosmahl has been working with Hughes in Torrance since March, Appleby said.

Lewis officials said the improvements could double the channels on a communication satellite. This is important, they said, because of the limited number of slots in space for satellites and the increasing demand for additional voice, picture and data transmissions.

"The way out of the jam is to make each satellite able to handle more traffic without affecting the quality of the signals," said Kosmahl, a 21-year veteran of Lewis, adding it is important to do this without having to increase the satellite's power supply.

Appleby, associate manager of the Hughes division's space tube department, said Kosmahl, using a computer, devised a better way to build electronic circuits within the traveling wave tube, which increase the circuits' efficiency and give less signal distortion.

The amplifer works by transferring the power of a stream of electrons to a radio wave that carries the communication. The new system helps to syncronize the transfer of power.

Kosmahl compared it with autos slowing down going uphill and unable to catch green traffic lights, preset at 35 miles per hour, to keep moving. "We simply match the speed of the lights to the flow of the cars," he said.

The new amplifiers are to be delivered to the firm's Space & Communications group in El Segundo, Calif., by next March for the 1985 launch.

Henry G. Kosmahl NASA

News Notes

Kosmahl named IEEE associate editor

Dr. Henry G. Kosmahl, head of Lewis' Microwave Amplifier Section, has been named Associate Editor for Electron Tubes for the IEEE society publication, "Transactions on Electron Devices."

His editor duties for the next three years will include reviewing for publication all submitted research reports in the field. In addition to the professional honor the office conveys, the post is an excellent method of keeping abreast of current developments in the field, he reports.

Kosmahl has served as head of the Microwave Amplifier Section since 1967. He is an IEEE fellow and recipient of several IEEE and NASA awards.

News Notes

Kosmahl honored by CECON

Dr. Henry G. Kosmahl, Lewis physicist credited with pioneering the development of the traveling wave tube and other communication satellite technology breakthroughs, will be awarded the CECON Medal of Achievement at the upcoming Conference for Electrical and Electronic Technologies in Cleveland.

The two-day CECON Conference, scheduled to begin Oct. 4, will feature the latest developments in electronics and computer intelligence technology.

Other Lewis representatives at the conference are Godfrey Anzic, who will present his work in gallium arsenide microwave monolithic integrated circuit technology; E. W. Spisz who will give a talk entitled, "A Satellite Switched SS-TDMA IF Switch Matrix" and Tony Powell who will talk about his recent developments in high-temperature semiconductors. In addition to receiving the award, Kosmahl also will present a talk, "Space Power TWT's -- Very Much Alive."

THE PLAIN DEALER
FRIDAY, OCTOBER 14, 1983n
PAGE 9-Cn

NASA scientist clears airwaves

By Thomas W. Gerdel

Discoveries by a scientist at NASA's Lewis Research Center could help prevent a communications satellite jam-up in space.

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A satellite with the improved technology is expected to be launched in 1985, said Tom Appleby of Hughes Aircraft Co.'s Electron Dynamics division in Torrance, Calif., which builds the amplifiers. Kosmahl has been working with Hughes in Torrance since March, Appleby said.

Lewis officials said the improvements could double the channels on a communication satellite. This is important, they said, because of the limited number of slots in space for satellites and the increasing demand for additional voice, picture and data transmissions.

"The way out of the jam is ton make each satellite able to handle more traffic without affecting the quality of the signals," said Kosmahl, a 21-year veteran of Lewis, adding it is important to do this without having to increase the satellite's power supply.

Appleby, associate manager of the Hughes division's space tube department, said Kosmahl, using a computer, devised a better way to build electronic circuits within the traveling wave tube, which increase the circuits' efficiency and give less signal distortion.

The amplifer works by transferring the power of a stream of electrons to a radio wave that carries the communication. The new system helps to syncronize the transfer of power.

Kosmahl compared it with autos slowing down going uphill and unable to catch green traffic lights, preset at 35 miles per hour, to keep moving. "We simply match the speed of the lights to the flow of the cars," he said.

The new amplifiers are to be delivered to the firm's Space & Communications group in El Segundo, Calif., by next March for the 1985 launch.

Henry G. Kosmahl NASA

Dr. Kosmahl will be honored

Dr. Henry G. Kosmahl, of the NASA Lewis Research Design Center, will benhonored at a luncheon todaynatnClevelandnEngineering Center.

KosmahlnwillnreceiveIthe first award in thencentennialncelebrationnofnthenInstitutenof Electricaln andn Electronicsn Engineeringn for acheivementsninnthendesignnofnelectrical components.

Thenaward is partnofnthentwo-dayn1983 ClevelandnElectronics Conferencenwhich will havensevennn workshopsn andn moren thann 25n exhibitors.

Dr.nY.H.nPao,nof CasenWestern Reserve University,nwill addressna 1:30np.m.nseminar todayn onnthen conceptnofn"intelligence"n inn industrialn productsn andn production procedures.

Exhibitnhours will be from 10 a.m. to 6 p.m. The workshops will be presented from 4:30 ton5:30 p.m.ntoday and tomorrow.nSeminarsnarenatn9:30na.m.nand 1:30np.m.nTherenis no admission charge for the workshops or the exhibits.n

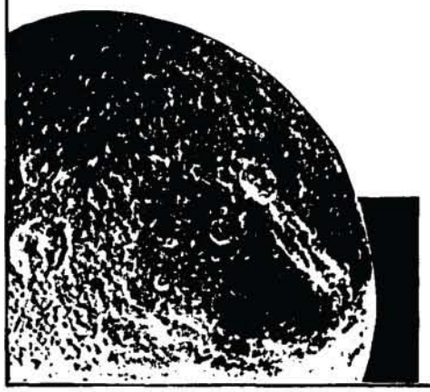
THE PLAIN DEALER, TUESDAY, OCTOBER 4, 1983n

NASA
National Aeronautics and Space Administration
Lewis Research Center

Volume 20 Issue 22 November 4, 1983

LewisNews

Future NASA planetary program stresses economy



To rendezvous and fly in formation with a comet, study the climate of Mars and map the surface of both Venus and Saturnian moon Titan: these are a few of the goals of NASA's planetary exploration program before the year 2000, according to Dr. David Morrison, a member of NASA's scientific advisory council.

In an ALERT-sponsored talk to Center staff, the University of Hawaii astronomy professor said these exciting missions must be accomplished with a budget of $300 million -- only a fraction of that which funded the historic Voyager, Viking and Mariner programs.

In an interview, Morrison characterized the next generation of planetary probes that will accomplish these tasks as being composed largely of off-the-shelf hardware. They may even utilize the chassis of existing, commercially available satellites.

Given the green light this year was the first of the bold initiatives, the Venus Radar Mapper. The probe is designed to give scientists a detailed view of the surface of Venus, which is cloaked in mystery by layers of dense clouds. It's radar imaging system was developed under a previous project.

Lewis' current work in adapting the veteran Centaur upperstage to the Shuttle is a key element in getting the Galileo atmospheric probe off to Jupiter in 1986.

"Developing exotic new technologies for new probes is no

Continued on page 3

Doubling channel capacity

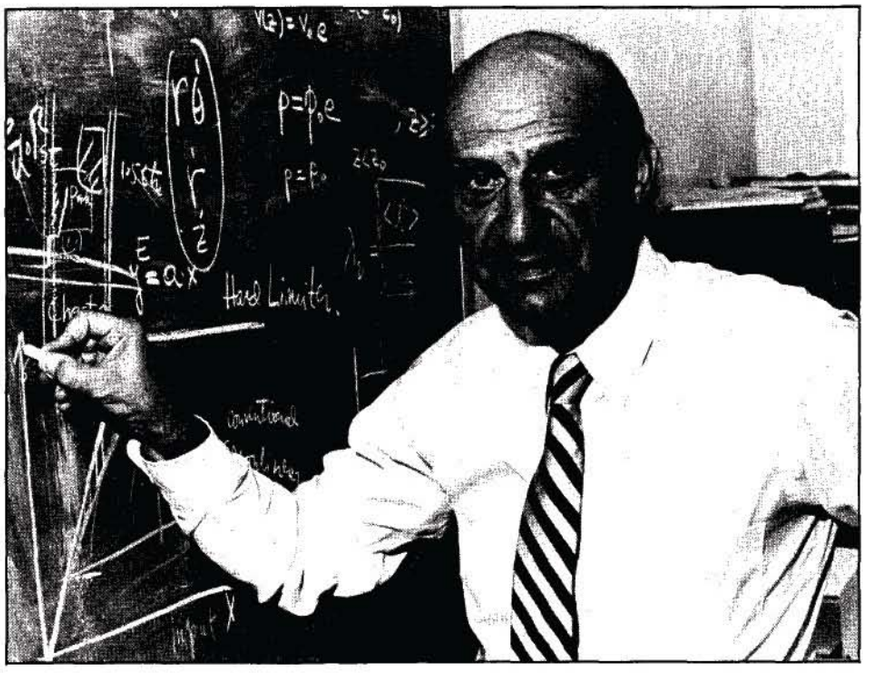
Continued from page 1

He added that the fixed number of satellite parking spaces available could be filled in less than 20 years if the pace of current satellite launchings continues.

"The way out of the traffic jam is to make each satellite capable of handling more traffic without affecting the quality of the signals," says Kosmahl. "It is also important that this be accomplished without having to increase the satellite's power consumption."

When explaining how his DVT accomplishes the task, Kosmahl likens the electronic processing of the radio signal to imaginary car traffic driving on an uphill street: "Traffic lights are set for a speed of 35 mph, but the cars slow as they go uphill and cannot keep pace to catch all the green lights.

"What we have done with the DVT is similar to readjusting the traffic lights so that despite the cars' loss of speed, they always catch green lights to keep moving. We simply match the speed of the lights to the flow of the cars."



IN BLACK AND WHITE - Dr. Henry Kosmahl explains the theory behind his Dynamic Velocity Taper. Paul Farace photo

Kosmahl emphasized that the synchronized dynamic transfer of power from the electron stream produced by the signal amplifier to the radio wave is the key feature of the development. A major side benefit of this system is that additional power is gained from the constant resynchronization of the radio wave with the stream of electrons produced by the amplifier.

"This means we can build a new satellite that is the same size as previous models but with double the capacity - or - build smaller, less expensive ones that would be far cheaper than current technology," he added.

Hughes Aircraft's Electron Dynamics Division - a major supplier of communmication satellites for much of the free world - already is using data furnished by Lewis to test the DVT and has reported early successes in efficiency and linearity.

Kosmahl has applied for a NASA patent on the DVT, which will be available to U.S. industry. Kosmahl currently holds 10 U.S. patents and six foreign patents and has three patents pending. In 1980, he received NASA's highest monetary award for his work in developing the Multi-Stage Depressed Collector.

NASA
National Aeronautics and Space Administration
Lewis Research Center
Volume 21 Issue 2 January 27, 1984
LewisNews

Lewis device could cut power usage in half for UHF-TV broadcasters

A device developed originally for use in advanced communications satellites is now being modified so it may directly benefit earth's UHF television stations by significantly reducing their electrical power consumption.

Under a $110,000 one-year contract just awarded by Lewis, Varian Inc. of Palo Alto, Calif. will adapt the compact radio wave amplifier technically called a multi-stage depressed collector (MDC) to current TV station transmitter equipment.

Originally developed by Lewis physicist Henry G. Kosmahl to improve efficiencies of communications satellites, the MDC allows more power to be utilized by any signal amplifying system.

In space, it results in stronger satellite signals and smaller, less-costly earth terminals. And in the transmitting sheds of terrestrial UHF TV stations, Kosmahl explained, the MDC can be wedded to a similar device called a klystron -- a vacuum electronic tube used by UHF stations to generate and amplify ultra-high frequency broadcast signals.

Klystrons at work at TV stations today can only achieve 10 to 15 percent efficiencies. With the aid of Lewis' MDC and another Lewis invention -- the spent beam refocuser -- efficiencies of up to 30 percent can be achieved, say Lewis scientists, with power savings to the station on the order of 50 percent over present levels.

The energy cost savings could allow UHF broadcasters, which includes the majority of the country's educational TV stations, options such as improved programming, reduced commercial time or increased power output allowing for improvement of the signal and, thus, larger audiences.

The contract with Varian marks the beginning of a planned three-year million-dollar technology transfer effort. Financing of the project is interesting in that NASA is to contribute $110,000 per year of Technology Utilization funds to the project; Varian Inc., the National Association of Broadcasters, and Public Broadcasting Systems will pay the rest. Varian Inc. is the largest manufacturer of UHF-TV klystron tubes in the United States and Canada. Sandy Felder of the Lewis T.U. office helped organize the cooperative project.

The great interest shown by private industry in the Lewis development is best illustrated by calculating the actual dollar savings to a typical UHF station broadcasting at 200,000 watts in a medium to large metropolitan area. This station buys about $300,000 worth of electricity per year to stay on the air. By 1985, with expected fuel surcharges and inflation increases, the electric bill for all the nation's UHF broadcasters could reach $100 million.

The application of the MDC to station transmitters could amount to a savings of some $45 million annually beginning in 1985. Installation and equipment charges for this device are expected to pay for themselves in one year.

Adaptation of the space device to terrestrial needs is part of NASA's ongoing efforts to stimulate the widest possible use of its technology through its highly successful Technology Utilization program.

Aviation Week honors Kosmahl

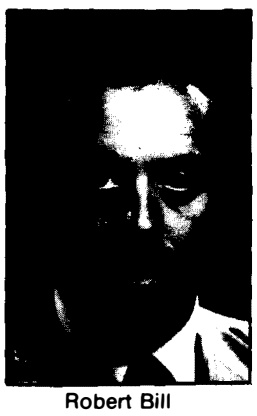
The editors of **Aviation Week and Space Technology** magazine have named Lewis' Henry G. Kosmahl among their distinguished aerospace contributors in 1983.

Kosmahl, head of the Lab's Microwave Amplifier Section, was honored for his research on microwave amplification technology that, according to the editorial in

Continued on page 2

Lewis inventors


Bruce Banks


Robert Bill


Gerald Brown


An-Ti Chai

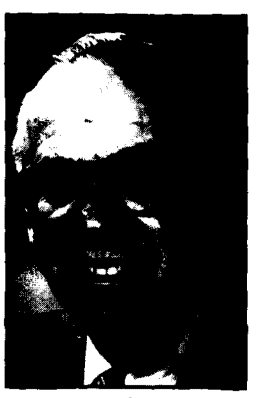

Arthur Curren


Daniel Deadmore


J. C. Evanse


Ralph Forman


Randall Gahn


Robert Graham


Louis Kiraly


Henry Kosmahl


Curt Liebert


Glen McDonald


James Morris


William Nagle


S. S. Papell


Margaret Reid

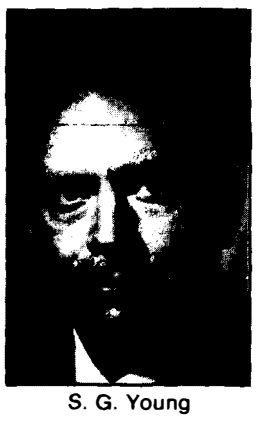

Dean Sheibley


Daniel Soltis


James Sovey

Lewis inventors for 1983 honored at awards luncheon


Edwin Wintucky


S. G. Young

Lewis inventors who received patents in 1983 were honored and presented plaques at the annual Inventors Awards luncheon Apr. 30 in the dining room of the main cafeteria.

Dr. John Klineberg, deputy director of Lewis, was guest speaker and made presentations at the ceremony.

Lewis Patent Counsel Norman Musial was master of ceremonies and explained the Inventor of the Year Award, an agencywide program.

Annually each NASA center submits one patent from that year to NASA Headquarters where one is selected for consideration in the national Inventor of the Year competition.

For 1983 a patent issued to Gerald V.eBrown for Magnetic Heate Pumping was the Lewis candidate.e

This year, though not for the first time, Lewis has one woman inventor, Margaret A. Reid, who is co-inventor with Randall F. Gahn and C.Y Yang of "Zirconium Carbide as an Electrocatalyst for the Chromous/Chromic."

Musial announced that the national inventor of the year is Robert Fishchell at Johns Hopkins Universities Applied Physics Laboratory.

Emphasizing the importance of obtaining patents on new devices, Dr. Klineberg said the Government often is suedefor damages if we or any of our contractors infringe a patent.

Nineteen Lewis employees who received patents inel983 and inventor plaques at the luncheon are: Dean W. Sheibley, Daniel L. Deadmore, An-Ti Chai, Bruce A. Banks, Robert C. Bill, Randall F. Gahn, Margaret A. Reid, Robert W. Graham, Gerald V. Brown, Glen E.eMcDonald, Henry G. Kosmahl, Louis J. Kiraly, Curt H. Liebert, Arthur N. Curren, Ralph Forman, James S. Sovey, Edwin G. Wintucky, Daniel Soltis and William Nagel.

Inventors who had patents issued in 1983 buteno longer are at Lewise include: J.F. Morris, S.G. Young, J.C. Evans Jr., C.P. Goradia, D.W.e Wisander, C.Y. Yang and S. Stephene Papell.e

Thirteen contractor employees also were granted patents and will have their plaques sent to them. □

Names of patents and last names of inventors are:

"Advanced Inorganic Separators for Alkaline Batteries and Method of Making the Same"; Sheibley

"Heat Pipes Containing Alkali Metal Working Fluid" and "Thermionic Energy Converters"; Morris

"Silicon-Slurry/Aluminide Coating"; Deadmore and Young

"High Voltage V-Groove Solar Cell"; Evans, Chai and Goradia

"Ion Beaen Sputter-Etched Ventricular Catheter for Hydrocephalus Shunt"; Banks

"Laser Surface Fusion of Plasma Sprayed Ceramic Turbine Seals", Wisander and Bill

"Zirconium Carbide as an Electrocatalyst for the Chromous/Chromic"; Gahn, Reid and Yang

"Curved Film Cooling Admission Tube"; Graham and Papell

"Magnetic Heat Pumping"; Brown

"Method of Forming Oxide Coatings"; McDonald

"Piezoelectric Composite Materials"; Kiraly

"Covering Solid, Film Cooled Surfaces with a Duplex Thermal Barrier Coating"; Liebert

"Ion Sputter Textured Graphite Electrode Plates"; Curren, Forman, Sovey and Wintucky

"Additive for Zinc Electrodes"; Soltis, Sheibley and Nagle

"Ladder Supported Ring Bar Circuit" and "Gyrotron Transmitting Tube"; Kosmahl.

LewisNews

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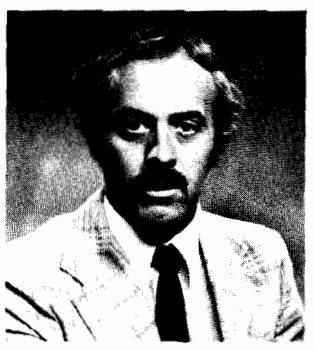
☆ U.S. G.P.O. 1984 759-037/22

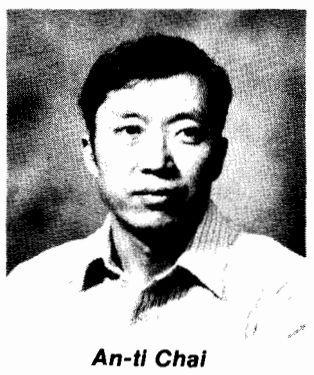
Inventor Awards


Bruce A. Banks


Cosmo R. Baraona


Robert C. Bill


Federick D. Calfo

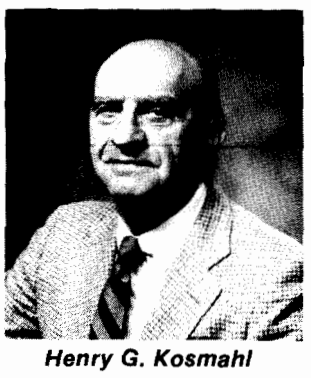

An-ti Chai


Jo Ann Charleston


Michael A. Gedwell


Thomas K. Glasgow


Robert P. Gruber


Henry G. Kosmahl


Stanley R. Levine

At a **Lewis Awareness Inventors Day Ceremony Program** held last month, 32 Lewis inventors/patent holders who have had patents issued in 1984 were honored. Among the honorees was Lynn M. Anderson, who received the Inventor of the Year Award.

In his ceremony remarks, Center Director Andrew Stofan discussed the necessity of securing patent protections. Stofan pointed out that the defensive aspects of Government-owned patents are important because private and public corporations are working on some of the same concepts in which NASA/Lewis is interested. "If we do not secure patent protection, and someone else does, we can be sued for infringement. I am told that current infringement claims against the Government total in excess of a billion dollars."

The Center director also focused on the recent change in viewpoint from the one held years ago that espoused the use of Government-owned patents primarily for defensive purposes. But today, exemplified by the President's pronouncement of the Government Patent Policy in 1971, such patents now also constitute a valuable national resource and should be utilized positively for the general public needs.

In addition, the licensing program of NASA enables Lewis to grant exclusive licenses to small business firms, minority firms and firms in an area of surplus labor so as to provide these firms with a monopoly to aid them to survive and compete in our private enterprise system. To further this concept, Congress passed legislation effective July '81 permitting small businesses to claim first rights in inventions made under Government contracts.

"Although there have been many articles written about the patent system, both pro and con," said Stofan, "history has shown us that other than by patenting, no other satisfactory method of protecting inventions has been found.

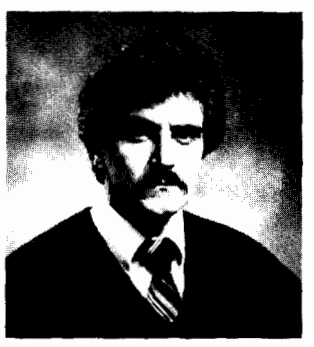
"It is interesting to note that although NASA was formed in 1958—13 years before the President's pronouncement in '71—the sponsors of the NASA legislation recognized that valuable inventions would result from the Space Program as almost one-fourth of the NASA Space Act is devoted to patent provisions and related subject matter," Stofan said. □

(Photos Continued on Page 4)

(Photos by Clifford Brooks)

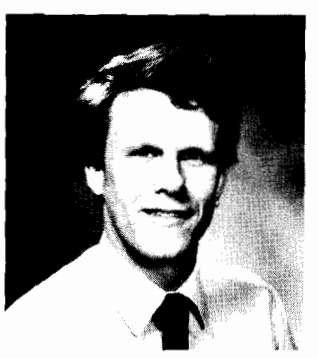

Frances I. Hurwitz


Richard W. Lauver


Michael W. Lupton


Michael J. Mirtich


Robert E. Post


Vincent K. Rawlin


Margaret A. Reid


William J. Rice


Robert F. Roman


Donald F. Schultz


Daniel G. Soltis

In ceremonies at Headquarters in March, NASA Administrator Dr. James Fletcher presented Dr. Henry Kosmahl with a plaque, certificate, and monetary award for being NASA's nominee for the National Inventor of the Year award sponsored by the Intellectual Property Owners, Inc. Dr. Kosmahl also received a plaque during the Lewis Inventors Day Awards ceremony.

NASA Nominates Kosmahl For IPO National Inventor Of The Year

Dr. Henry Kosmahl, a Lewis retiree working part-time as an Analex consultant to the Space Communications Division, was selected as NASA's nominee for the National Inventor of the Year award sponsored by Intellectual Property Owners, Inc. (IPO). This is the first time an inventor from Lewis has been chosen for this honor.

His invention, entitled "Linearized Traveling Wave Amplifier with Hard Limiter Characteristics," was selected not only for its technical merit but also based on its potential commercial sales and availability.

The essential element of the invention is its Dynamic Velocity Taper (DVT). By matching the phase velocity of the wave to be amplified to the dynamic condition present on the beam, three important effects are realized: the efficiency is increased by about a third; the amplification is linearized, and the amplifier saturates with hard limiter characteristics. This makes the Traveling Wave Tube (TWT) highly superior to solid state Field Emission Transistors (FET) in all aspects of operation.

The invention is being used by industry in communications satellite applications and by the Air Force in its Global Satellite System. It may also be used for NASA deep space missions into the 21st Century and in many advanced radar applications.

In ceremonies at Headquarters in March, NASA Administrator Dr. James Fletcher presented Dr. Kosmahl with a plaque, certificate, and monetary award. Dr. Kosmahl also received special congratulations from Acting Director Dr. John Klineberg and Chief Counsel William Brahms during the Lewis Inventors Day Awards Ceremony April 10.

The IPO National Inventor of the Year is scheduled to be named later this spring and honored at a reception on Capitol Hill.

"I am deeply honored by this nomination," said Dr. Kosmahl. "I am very grateful to Lewis for having given me the opportunities and support to pursue my field of work."

A new temporary ramp at the back entrance to Bldg. 60 enables employees in wheelchairs to visit the Lewis library or consult with members of the editorial and graphics staffs.

National Aeronautics and
Space Administration

Lewis Research Center Volume 24 Issue 17n August 21, 1987

Lewis Invention May Help UHF-TV Stations Cut Operating Costs

More than 400 UHF-TV stations across the nation may soon be able to cut their operating costs by hundreds of thousands of dollars a year, thanks to an invention developed at Lewis. In cooperation with the National Association of Broadcasters (NAB), Public Broadcasting System (PBS), and the Center's Technology Utilization (TU) Office, Varian Associates, Inc. of Palo Alto, CA, has completed the design and initial testing of a multistage depressed collector (MDC)napplicable to UHF-TVn klystrons.n

MDC's were originally developed at Lewis to decrease the electrical power needs of high power communications satellites.

For UHF-TV stations, the MDC is expected to double the efficiencies of the klystron—the broadcasting tube that sends the signal to the station's antenna where it is then spread to the users. Increasing klystron efficiencies will result in significantly lower electrical costs for the stations.

Currently, UHF klystrons for AM TV service have average overall efficiencies of only 10 to 15 percent. Tests on experimental models developed by Varian show that MDC's will enable klystrons to achieve average efficiencies of 30 percent and more.

For a typical 200,000 watt UHF-TV station in a medium-to-large metropolitan area, this increase in efficiency will enable electrical costs to be cut in half—from $300,000 a year to $150,000. Such savings will be especially valuable to public television stations that depend on private funds for their operations.

Initially Designed For Spacecraft

The MDC was invented by Dr. Henry Kosmahl and was patented in 1972. It is a passive energy recovery device that converts residual kinetic power of the spent electron beam into electric power.

The depressed collector was originally designed to help raise the efficiency of broadcasting tubes on spacecraft. Previous tubes had efficiencies of only about 20 percent, which meant that the electrical power generated by the spacecraft's solar array had to be more than five times greater than the broadcast power. The low tube efficiency meant spacecraft had to be larger, heavier, costlier, and more complex. The enhanced efficiency made possible by the MDC paved the way for a new class of high power space transmitters.

Initially, the depressed collector helped tubes reach efficiencies of 50 percent and was incorporated in the Communications Technology Satellite, launched in 1976.

Over the years, the Space Communications Division has developed and perfected multistage depressed collectors. Today, collectors recover as much as 80 to 90 percent of the electron energy and are widely used in spacecraft, avionics, and military applications.

Benefitting From Lewis Technology

Varian Associates, Inc., the largest manufacturer of UHF-TV klystron tubes in the United States and Canada, has been working on a program to adapt Lewis-developed MDC technology to their needs since 1984.

The program was initially proposed by the TU Offfice to the NAB and manufacturers whose products compose parts of the klystron. In addition to Varian, contributors to the program include the NAB, PBS, Harris Corp., RCA, Townsend Associates, and Connecticut ETV. Dr. James Dayton, Jr., chief, and Peter Ramins, of the Electron Beam Technology Branch of the Space Communications Division, served as consultants.

Using computer-aided design, Varian Associates developed an MDC design that can be applied to all UHF-TV klystrons, including low, mid, and high band, 30 and 50 kW, 4- and 5- cavity, and internal and external cavity models.

An experimental model was constructed and demonstrated that the resulting improvements in the efficiency of the klystron could reduce prime power consumption to half.

In September, Varian scientists plan to present a paper about the MDC design for UHF-TV klystrons to the 1987 IEEE Broadcast Symposium.

NASA
National Aeronautics and Space Administration

Lewis Research Center Volume 24 Issue 20 October 2, 1987

LewisNews

NASA Wins Emmy Award For CTS

An Emmy Award for outstanding achievement in television engineering was presented to NASA for developing satellite technology which ultimately improved television broadcasting throughout the world.

The National Academy of Television Arts and Sciences presented the award for the Communications Technology Satellite (CTS), a joint project between the United States and Canadian governments. Since Lewis was responsible for the United States portion of the CTS project, Center Director Dr. John Klineberg accepted the award at the Engineering Emmy Award Dinner Sept. 16 in New York.

"The success of this project is a tribute to the men and women of both countries whose hard and creative work led to the technical achievement we are recognizing tonight," said Dr. Klineberg in his acceptance speech. "The Communications Technology Satellite project is a superb example of how the governments of different countries can work together to improve the quality of life throughout the world. I am particularly proud of NASA's association with this highly successful project."

First In New Frequency Band

Launched in 1976, the CTS was the first communications satellite to incorporate the use of a high-efficiency, high-powered transmitting tube developed at Lewis. The tube made it possible for the CTS to operate at power levels 10 to 20 times higher than those used at the time, and in a new frequency band, the Ku band, allocated to broadcast satellites. This higher broadcast capability made it possible to use much smaller and far less expensive ground receiving equipment than ever before. It also enabled transmission to remote areas where terrestrial communications are not highly developed.

Many domestic and foreign communications satellites in operation today are using the technology first demonstrated by the CTSo

The Center's role in the CTS project included developing the high-power transmitter tube for the spacecrafto conducting environmental tests, and providing the launch vehicle and launch serviceso The spacecraft was developed by the Communications Research Centre in Ottawa, Canadao

The United States and Canada shared equally in satellite experiment time. Both countries encouraged participation from a wide variety of organizations such as state and local governments, universitieso hospitals, in-

The CTS transmitter was turned off in October of 1979 after more than three years of successful experimentation.

Instrumental In Other Emmy Winning Project

NASA was also recognized for its efforts in advancing UHF transmitter efficiency, for which the Public Broadcasting System (PBS) received an Emmyo Lewis was instrumental in the development of improved UHF transmitter efficiency because of its work on Multistage Depressed Collectors (MDC's). The MDC, invented by Dr. Henry Kosmahl to decrease the electrical power needs of high power communications satellites, was used on the CTS.

Varian Associates, Inc., in cooperation with the National Association of Broadcasters, Public Broadcasting System, and Lewis, has completed the design and initial testing of an MDC applicable to UHF-TV klystrons, the tube then sends the signal to the station's antenna. Increasing the klystron efficiency will enable UHF-TV stations to significantly reduce their electrical costs. *(See Aug. 21, 1987 Lewis News.)*

In addition to NASA, the Communications Research Centre of Canada, and PBS, other organizations honored at the Engineering Emmy Award Dinner were: Dubner Computer Systems, Inc.; Color Systems Technology, Inc.; Colorizationo Inc.; SMPTE; and the European Broadcasting Union.

Lewis retiree Dr. Henry Kosmahl displays the Emmy Award presented to NASA for its role in the Communications Technology Satellite (CTS) project. Television broadcasting throughout the world has been improved as a result of the satellite technology first demonstrated by the CTS.

Dr. Kosmahl invented the Multistage Depressed Collector (MDC)owhich helped make it possible for the CTS to operate at powero levels 10 to 20 times higher thano previous satellites.o

Before the Emmy was taken to Headquarters for presentation to Administrator Dr. James Fletcher, some of the many Lewis employees and retirees who had worked on the project gathered to take pride in having their accomplishments recognized with this prestigious award.

Shown above with the Emmy and a model of the CTS are some of the employees who worked on CTS project operations: (left to right) Robert Brej; Kenneth Jensen; Michael Higgins; Edmund SmithoJames Ely, Jr.oRichard Krawczyk; John Rhyder; and William Loftus.

Ebihara Wins Space Act Award For Improving MDC Efficiency

NASA Inventions and Contributions Board has granted a $2,000 Space Act Award to Ben Ebihara of the Space Electronics Division. Ebihara received the award for designing a method of making multistage depressed collectors more efficient, more compact, and easier to manufacture.

Multistage depressed collectors (MDC's) were originally invented at Lewis by Dr. Henry Kosmahl to help raise the efficiency of the traveling wave tubes (TWT's) used on satellites. MDC's recover and recycle a significant part of the energy from the electron beams used by TWT's for signal amplification.

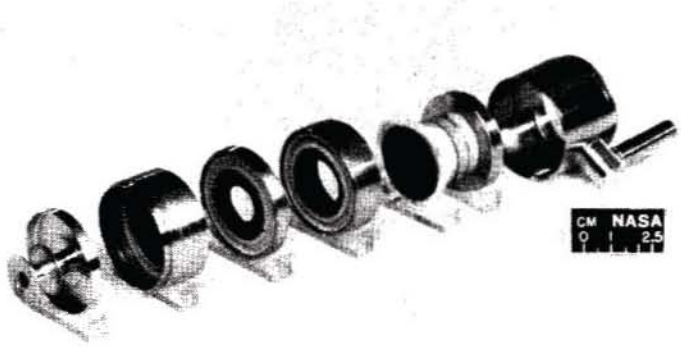
Ebihara's design, which uses graphite MDC electrode surfaces instead of machined copper surfaces, enhances TWT efficiency by reducing secondary electron emission effects. His modular construction design also makes the collectors easier to manufacture and aids texturization of the electron collecting surfaces. In addition, Ebihara's innovations reduce MDC weight and size, which are important considerations for critical space and airborne applications.

Early prototypes of the device were built by the Fabrication Support Division.

"This was not easy, because the design requires precision machining, assembling, and joining techniques," says Ebihara. "Uncommon, unfamiliar, and often incompatible materials had to be brazed and welded."

Although the improved MDC's are still in the early development phase, Ebihara reports that they do show a great deal of promise: "The collectors have successfully undergone testing at actual operating conditions with representative TWT's. We are in the process of transferring this technology to industries that could benefit."

Ben Ebihara (center), is congratulated by Center Director Dr. John Klineberg (second from left) and Director of Aerospace Technology Dr. J. Stuart Fordyce (second from right) for receiving a Space Act Award. Also on hand



Ebihara's design calls for the multistage depressed collector to be constructed by stacking one or more subassemblies, each with a graphite inner ring. By successfully incorporating graphite MDC electrode surfaces instead of the machined copper surfaces commonly used, Ebihara's design offers a substan-

CTS Project Team Gathers To Celebrate Emmy Display

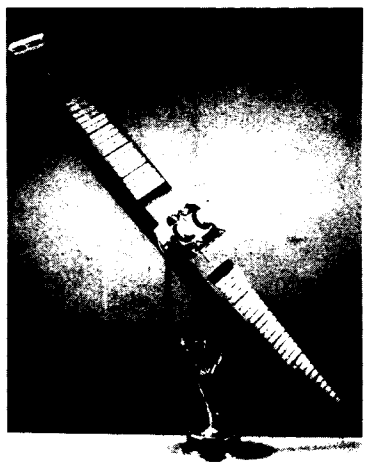
Many of the employees and retirees who had contributed to the Communications Technology Satellite (CTS) and its operation in the 1970's gathered in the Visitor Center Thurs. evening, May 26 for an Emmy Appreciation Ceremony.

The Emmy, which was awarded to Lewis last fall, has been installed as a permanent display in the lobby of the Visitor Center. The first Emmy ever to be presented to a government agency, the award was given to NASA and the Communications Research Center of Canada by the National Academy of Television Arts and Sciences for developing technology which ultimately improved television broadcasting throughout the world.

Launched aboard a Delta from KSC in 1976, the CTS was the first communications satellite to incorporate a high-efficiency, high-powered transmitting tube invented by Lewis researcher Dr. Henry Kosmahl. The tube made it possible for the CTS to operate at power levels 10 to 20 times higher than those ever used before and in a new frequency band, the Ku band. This higher broadcast capability made it possible to use much smaller and far less expensive ground receiving equipment than ever before and demonstrated that super powerful systems can bring remote areas anywhere on the globe within easy, low-cost television reach. Many domestic and foreign communications satellite in operation today are using the technology first demonstrated by the CTS.

160 U.S. Experiments

The CTS was a joint project of the U.S. and Canadian governments. The spacecraft itself was developed by the Communications Research Center in Ottawa, Canada. Lewis was responsible for the U.S. portion of the project which included developing the high-power transmitter tube for the spacecraft, environmental testing, and providing the launch vehicle and launch services. The United States and Canada shared equally in satellite experiment time.



"The Emmy represents recognition for an excellent technical achievement—one in which Lewis led NASA, the country, and the world."

Before the CTS transmitter was turned off in October of 1979, more than 160 U.S. experiments had been successfully conducted during three and half years. The experiments demonstrated the feasibility of using satellites for business teleconferences, emergency communications from disaster sites, and communications with remote sites.

For example, the CTS was put to use during the disastrous flooding in Johnstown, PA, in 1977, and was used to enable Indian leaders in Montana and New Mexico to discuss their concerns with government officials in Washington, DC. The CTS was also used for a United Nations conference and for educational and medical teleconferences.

Many of the experiments and demonstrations were made possible by the Portable Earth Terminal (PET), a 35-foot bus that Lewis had equipped with a teleconference room, satellite transmitting and receiving equipment, and an 8-foot parabolic antenna on the roof. During the operation of the CTS, the PET logged more than 62,000 road miles.

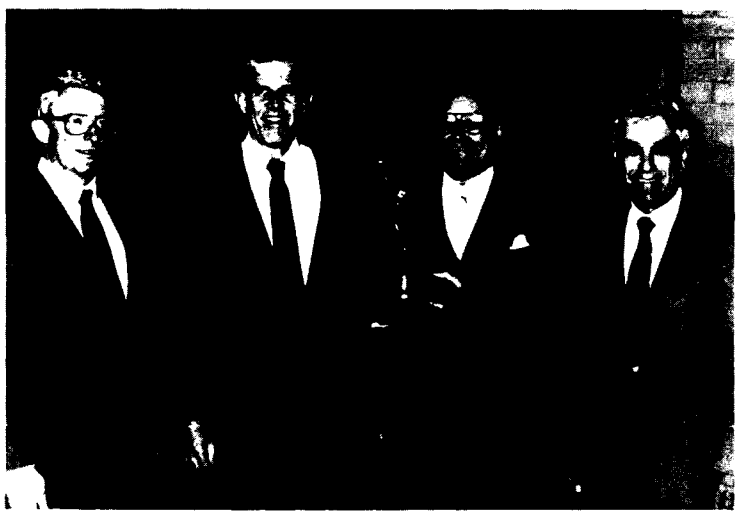
Emmy Display

The names of many of the contributors to the CTS Project are listed on a plaque next to the new Emmy display in the Visitor Center. The display also includes a plaque that explains more about the CTS.

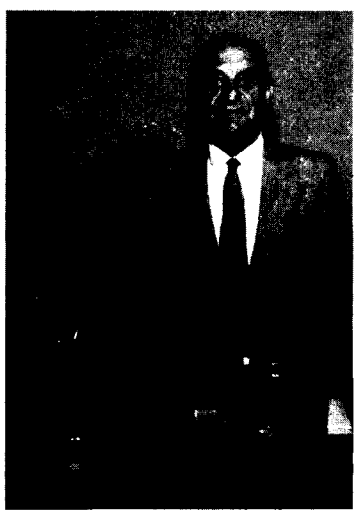
Berrie Torgan, an exhibit coordinator in the Visitor Center, said the display has attracted a lot of interest from visitors to Lewis, although some initially confuse the Emmy with an Oscar.

Still, as CTS team member Ed Miller puts it, the Emmy is a famous and prestigious award that represents "recognition for an excellent technical achievement—one in which Lewis led NASA, the country, the world."

The management team for the CTS Project included: (left to right) William Hawersaat, deputy project manager; William "Red" Robbins, project manager; and Patrick Donoughe, U.S. Experiments Manager. Other project leaders were Henry Slone and Elmer Davidson.

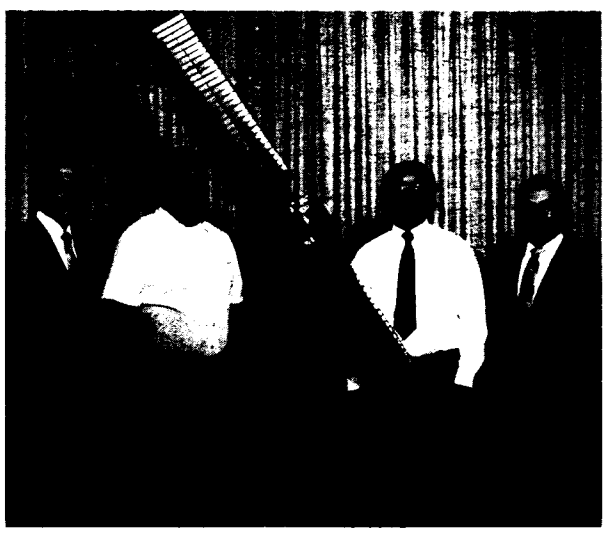


Among those who provided technology support were: (left to right) Dr. James Dayton, Jr., Dr. Denis Connolly, Robert Alexovich, and Joseph Sivo.



Dr. Henry Kosmahl invented the high-efficiency traveling wave tube (TWT) that made the high-powered CTS possible.

CTS Project Office personnel included: (left to right) Leonard Rizzolla, Erwin Edelman, Guy Gurski, and Robert Evans.

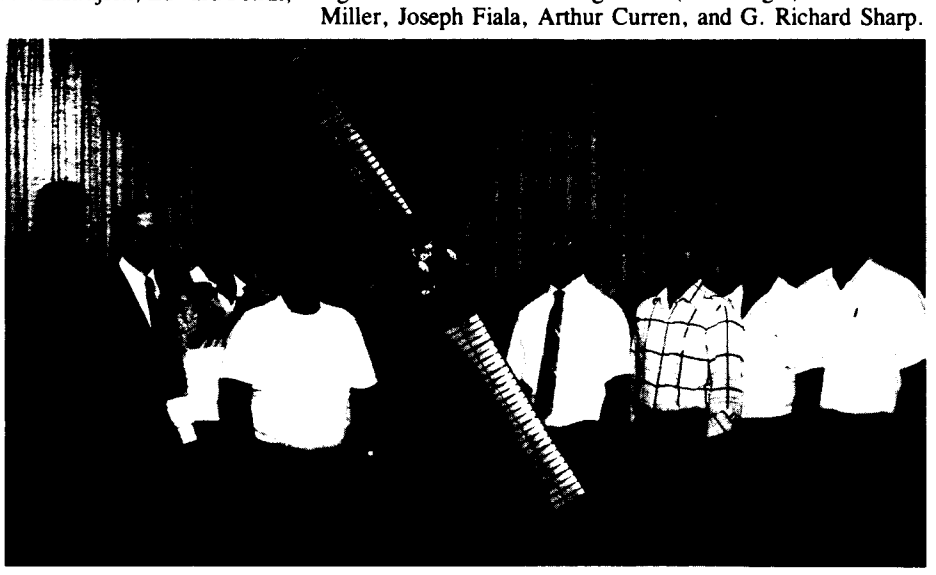


Some of the engineers who supported spacecraft operations were: (left to right) Louis Ignaczak, Robert Zakrajsek, Edward Petrik, and James Rotnem.

Some of the engineers who supported transmitter package integration and on-orbit testing were: (left to right) Dr. Edward Miller, Joseph Fiala, Arthur Curren, and G. Richard Sharp.

The Transmitter Experiments Package Development Office included Gerald Chomos (right) and Clifford Siegert.

Two of the technicians who supported the transmitter package development and testing were Gary Lesny (left) and Frank Rudin.



Some of the technicians who supported spacecraft operations were: (left to right) Robert Brej, Kenneth Jensen, Michael Higgins, Edmund Smith, James Ely, Jr., Richard Krawcyk, John Rhyner, and William Loftus.

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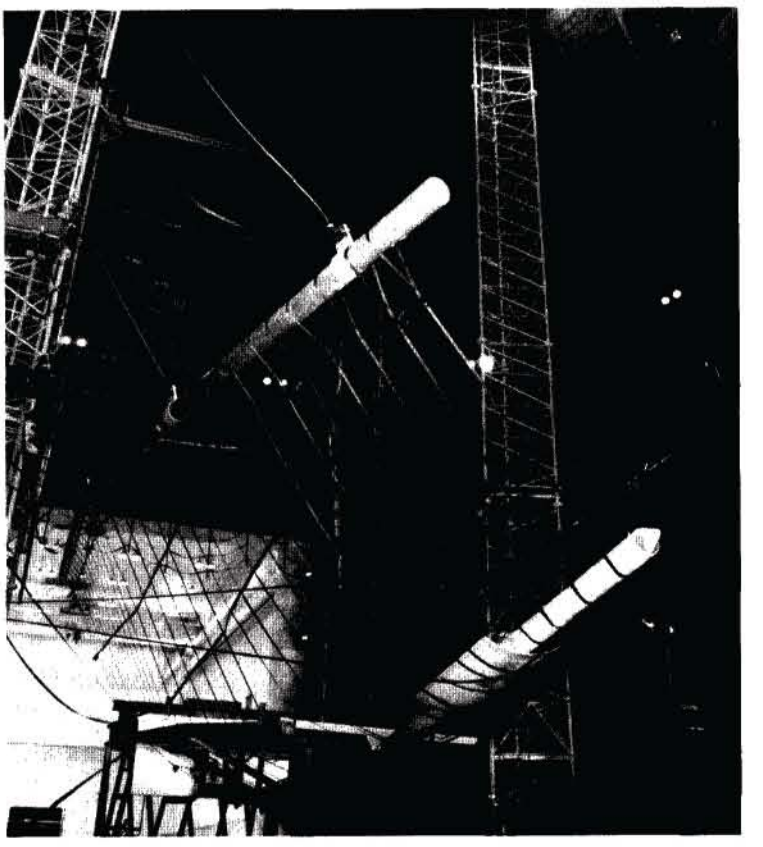

A mock-up Centaur shroud jettison test was successfully performed in the Space Power Facility at Plum Brook on October 4. The test was to demonstrate the acceptability of the catch-net system.

Lewis Technology Wins Three R&D 100 Awards

Lewis researchers won three Research and Development 100 awards for the Center this year, bringing the total number of R&D 100 awards the Center has won over the years to 58.

Sponsored by Research and Development magazine, the awards are presented to researchers who have introduced new products to the market during the previous calendar year. The 100 most significant products are selected for awards.

The magazine has sponsored the competition for approximately 25 years, and during that time Lewis has won about 75 percent of all NASA awards. In 1988, the Center won two awards. Banner award-winning years were 1977 and 1978 when the Center submitted eight entries and won five awards each year.

Originally called I-R 100 awards by Research and Development magazine, the award name was changed to R&D 100 awards in 1987. Lewis is the only NASA center to hold a spot in the list of 16 top all-time winners; the Center falls into the fifth spot while NASA, as a whole, holds the number three spot.

The 1989 award-winning products are described below.

A joint venture between Lewis employees Peter Ramins and Dr. James Dayton, Jr., both of the Electron Beam Technology Branch, ANALEX employee Dr. Henry Kosmahl and principal developer Earl McCune, senior scientist, Varian Associates, Palo Alto, CA, resulted in the development of the Varian Associates Model VKP-7990.

The entry is a multistage depressed collector (MSDC) klystron amplifier intended for use as the final amplifier in UHF television transmitters. It incorporates an advanced design MSDC to improve the overall efficiency of the electrical system by recovering from the spent electron beam some of the residual kinetic power that would ordinarily be dissipated as heat.

Originally developed to increase the efficiency of spaceborne radio transmitters, the technology cuts UHF television transmitter electrical power consumption by half. Compared to typical klystron transmitters currently in use, this will result in annual savings of over 400,000 kilowatt hours or $30,000 per klystron (an electron tube in which bunching of electrons is produced by electric fields and which is used for the generation and amplification of ultrahigh frequency current.) This represents a significant monetary savings for UHF TV stations and helps conserve natural resources by reducing electrical power consumption.

Over 1,000 transmitters are presently in operation that could benefit from the MSDC klystron. Other foreseeable applications of the concept include improving the efficiency of microwave communications systems; radar systems; microwave heating systems; and particle beam accelerators.

Development of the multistage depressed collector klystron amplifier started in June

Continued on page 6

Lewis To Host Workshop On Cathode Technology

More than 120 scientists and engineers from around the U.S., Europe, and Japan will come to Cleveland April 3-5 for the 1990 Tri-Services/NASA Cathode Workshop.

Hosted by Lewis, the workshop will be held at the Sheraton City Centre (formerly the Bond Court) Hotel. It will focus on the latest developments in cathode technology. Cathodes are used primarily in microwave tubes for space communications, radar systems, and other high-frequency, high-power electronic devices.

The biennial workshop is traditionally hosted by the Army, Navy, or Air Force.

"This will be NASA's first year as co-sponsor," reports Workshop Chairman Edwin Wintucky, of the Space Electronics Division. "The fact that Lewis is hosting it reflects our emergence as one of our nation's foremost supporters among government laboratories of cathode research and technology."

Center Director Dr. John Klineberg will give the welcoming remarks. Lewis retiree Dr. Henry Kosmahl, who is widely known for his innovations in traveling wave tube technology, will give the keynote address.

Eight of the 45 technical papers to be presented at the workshop will describe work done either at Lewis or supported directly by NASA contracts.

One full session will be devoted to the recently developed scandate-type cathodes. Developed primarily for use in high-definition TV, scandate-type cathodes are being investigated at Lewis for possible space applications.

Inventors Honored At 15th Annual Inventors Day Luncheon

Seven scientists and engineers whose inventions were patented in 1989 were honored at the 15th Annual Inventors Day Luncheon April 12. During the ceremony, Center Director Dr. John Klineberg noted that because of the potential applicability of many of the Center's inventions, Lewis leads all other NASA Centers in the amount of royalty distributed to its inventors.

Each inventor received a plaque bearing a replica of the first pages of his patent.

Dr. William Alston (left) of the U.S. Army Aviation R&T Activity Propulsion Directorate received two patents related to polymer research with co-inventor Roy Gratz (not shown) of Mary Washington College in Fredericksburg, VA.

Al Juhasz (second from left) of the Power Technology Division, engineering consultant Ralph Greenberg (third from right), and James Burkhart (second from right) of the Electronic and Control Systems Division, received a patent for an energy-efficient method of separating gaseous mixtures.

Henry Kosmahl of Analex Corp. (third from left) patented a miniature traveling wave tube and a method for making one.

Donald Schultz (right) of the Space Station Freedom Systems Integration and Engineering Division received a patent for a steam-cooled rich-burn combuster liner.