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Reduction to Practice of Space Inventions

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SUMMARY

The legal concept of actual reduction to practice can be a significant factor in obtaining patent protection for an invention. It is well established that to prove actual reduction to practice, it must be shown the invention worked as intended in its practical contemplated use; and the acts relied on for reduction to practice cannot occur in a foreign country.

To show that an invention worked as intended in its practical contemplated use, a complete operative embodiment must be constructed and subjected to some degree of testing; and depending on the circumstances this testing may be under conditions of actual use; in a simulated environment which duplicates the essential conditions of actual use, or in some instances it may be bench testing which does not simulate all the conditions of actual use. The type and degree of testing necessary to show reduction to practice is discussed, with emphasis on inventions intended to be used in a space environment.

Consideration is also given to situations where an invention may have been first actually reduced to practice in outer space, and whether this can be used to establish a date of invention under United States patent law. The extent of territorial sovereignty in the airspace above a nation's boundaries is considered, along with the ramification of operation of the invention beyond this territorial sovereignty. It is concluded that reduction to practice in outer space is tantamount to reduction to practice in the United States, based on one of two theories: the operation of an integrated instrumentality, wherein the invention is not removed from the United States by reason of the spacecraft being necessarily distant; and a free space doctrine, wherein occurrences onboard the spacecraft remain under the jurisdiction and control of the launching or registry nation.

INTRODUCTION

An engineer, a technologist, a space scientist has an idea for an improved device, apparatus or system that has particular applicability to a space mission. It may come to him instaneously, in a flash of genius, or it may evolve as the result of extended study and numerous trade-offs. In either instance, once a definite idea has been formulated a sequence of events are triggered, beginning with sketches, drawings, a written description and other documentation which under patent law evidences the conception of an invention; and culminates in the successful operation of the device, apparatus or system on a spacecraft in outer space. At various times during this sequence of events certain scientific and technological contributions will have been made, and certain legal occurrances and the attending consequences will have taken place. The most significant legal occurrance may very well be the first actual reduction to practice of the invention, and the consequences flowing therefrom may be determinative of the inventor's rights to the invention.

Assume now that the originator of the idea feels he has made an invention of significant value, and after due consideration and counseling he causes a patent application to be filed. If the requisite conditions for patentability are present [1], he can expect that in due course a patent will issue from the United States Patent Office in his name creating a valuable property right in either he or his employer.[2] He then turns his attention to developing the invention and convincing management of its merits. In the course of these activities he will make some breadboard models, crude at first, to satisfy himself of the feasibility of his concept. Subsequently more sophisticated models and prototypes will be built and subjected to further tests, perhaps under simulated environmental conditions. Concurrently his employer submits a proposal to a government agency, or another corporation contracting with a government agency, and a contract is negotiated to develop equipment that incorporates the invention. Ultimately a spacecraft is launched and the equipment, including the invention, performs to perfection. Meanwhile the inventor has all but forgotten his patent application, or the patent issuing therefrom, and is surprised when his patent attorney informs him of pending litigation wherein he must prove when he made his invention or run the risk of losing the patent rights.

BACKGROUND

There are numerous circumstances that can arise which require the inventor to prove when he first completed his invention, and pivotal to this is often the ability to prove the exact date the invention was first actually reduced to practice. Exemplary circumstances include the possibility that, sometime between the conception of the invention and its successful operation in outer space, the invention has been claimed in a copending patent application; the invention has been described in a prior patent or printed publication; someone else alleges to have made the invention; or, as mentioned, the inventor's employer entered into a contract to perform research and development work with a governmental agency or another private company.[3] The legal consequences of the inability to prove first actual reduction to practice may be the lost of priority in an interference, the rejection of the application by the Patent Office, the invalidating of the patent in an infringement suit or the vesting of certain rights in a contracting agency.[4]

What, then, are those factors that constitute the "making" of an invention, and how does the legal concept of reduction to practice enters into the picture? The United States patent system, somewhat unique

among the industrial nations of the world, is based on the first to invent concept and tends to reward the inventor who first put the invention to use. As a result an emphasis is placed on how, and when, an invention becomes legally complete, or is made, under patent law. Over the years a body of patent law has developed which views the making of an invention as a two-step process involving a mental element and certain physical acts. The mental element is termed the conception of the invention and occurs when an inventive idea has crystalized in all its essential attributes and becomes so clearly defined in the mind of the inventor as to be capable of being converted to reality and reduced to practice by the inventor or one skilled in the art.[5]

It is the physical acts that follow the conception, the acts of demonstrating by the construction and testing of an operative embodiment capable of a practical contemplated use, that constitute a reduction to practice of the invention. An invention is not considered legally complete until both of these elements, the conception and the reduction to practice, have been carried to completion.[6] It follows, therefore, that the exact date on which an invention becomes legally complete, or more significantly the date it was first actually reduced to practice, will often sustain the validity of a patent, control priority of invention between two interfering applicants, or will be determative of rights as between the inventor (and his assignee) and a contracting agency.[7]

REDUCTION TO PRACTICE IN GENERAL

To prove actual reduction to practice it must be shown that the invention worked as intended in its practical contemplated use; and that the acts relied on occurred in the United States. This latter requirement comes from a consideration of 35 U.S.C. 102, particularly Sections 102(a), (b) and (g), which provide that knowledge and use of an invention outside this country cannot defeat an inventor's right to patent; and from 35 U.S.C. 104, relating to inventions made abroad, which prevents an applicant for a patent, or a patentee, in a proceeding in the Patent Office or the Courts, from establishing a date of invention in a foreign country except in limited circumstances.[8] The underlying reasons for this geographic constraint is to provide uniformity of practice and procedural convenience, and has generally been applied by the courts when one attempts to establish a date of invention based on activities in a foreign country.[9] It does not provide a positive requirement that an invention must be made in the United States; but rather, is a negative limitation that prevents the establishment of a date of invention, including reduction to practice, from being based on acts in a foreign country.

To show that an invention worked as intended in its practical contemplated use, a complete operative embodiment must be constructed and subjected to some degree of testing.[10] While there may be some inventions so simple in their construction, operation and purpose that mere assembly and visual inspection is sufficient, the vintage of cases on this point and the nature of the inventions involved indicate that they have no practical significance in advancing the state of the art of sophisticated space technologies.[11] And even where tests are not required, the apparatus that was assembled must be a complete device capable of actual use and not merely a model or experiment.[12] Thus as a general rule it is necessary to construct a complete, operative embodiment of the invention, and to test it to an extent sufficient to establish that it worked as intended in practical use.

A. The Requirement of Testing

The type and degree of testing required will depend on the nature of the particular apparatus, its intended environmental setting, and the state of the art at the time the tests were performed. It goes without saying that successful operation of an invention under actual conditions of intended use will establish reduction to practice. It is also equally clear that tests which simulate or duplicate the essential conditions of actual use may also be used to establish actual reduction to practice. Of further importance are recent cases indicating the acceptance of "bench tests" that do not necessarily duplicate each and every condition of actual use as the basis for a reduction to practice, provided the evidence establishes a relationship between the test conditions and the intended functional setting of the invention.[13] In many of the cases involving bench testing in which no reduction to practice was found it was not because the court would not accept testing of this type, but rather because the evidence failed to establish the required relationship between the tests actually performed and the intended functional setting of the invention.[14] It is therefore important to have a well thought out test plan, precisely defined test parameters, and above all carefully documented test results.

The Courts have also held that information to establish feasibility of concept, even though encouraging, is not sufficient to establish an actual reduction to practice.[15] This is particularly true in arts not fully developed, such that adequate experience or standard test procedures do not exist and the test results are not readily correlatable with the intended functional setting of the invention. Thus in a developing art one should be particularly wary of prototype models, mock-ups, demonstrations and other pre-contract activities that may form the basis for a proposal for a research and development effort. It does not necessarily follow that since this activity was sufficient to win a contract award or obtain follow-on procurement it also was adequate to establish a reduction to practice under patent law. This point is emphasized in a recent Armed Services Board of Contract Appeals case[16] and a decision by a Board of Patent Interferences under Section 305(d) of the NAS Act.[17] In each case prototype models were fabricated and subjected to some testing, which fact was reflected in a proposal, and a patent application was filed prior to award of the contract. The principle issue in both cases was whether it was this pre-contract activity or work performed under the contract that constituted the first actual reduction to practice of the invention. In both cases it was held that the precontract prototypes and testing thereof was insufficient to constitute an actual reduction to practice. While both cases involved the question of a subject invention under a

government contract, the results probably would have been the same in litigation between private parties in that the respective tribunals applied the general body of patent law that has been developed on the issue of reduction to practice.

It is therefore apparent that for an invention intended to be ultimately used in outer space there may be, but it is not conclusive that there will be, some type and degree of testing possible here on earth that will be sufficient to constitute an actual reduction to practice under patent law. Since the earliest date of invention is the most beneficial, the importance of fully and realistically assessing bench testing and/or environmental testing rather than relying on operation of the invention under actual conditions of use in space as the basis for reduction to practice cannot be overemphasized.

Before relying on any type of testing it is important to make sure the device or apparatus actually tested is the same as that claimed as the invention. A patent application is a complicated technical-legal document comprising of a specification, drawings and claims, and it is the claims as finally allowed by the Patent Office that define the invention. The apparatus or device tested must embody all the material elements of one or more of these claims; it is not enough that whatever is tested incorporates some of the elements of the claims or that it is generally similar to what is described in the specification. In addition, piece-meal testing of individual components or sub-components of a system, no matter how exhaustive or successful this testing may be, is insufficient to constitute a reduction to practice. The testing must be of a complete operative embodiment of the entire combination as defined by the claims.[18]

B. Space as an Environmental Setting

The court are unaminous in their view that the amount of testing to establish reduction to practice necessarily depends on the nature of a particular invention and it is perhaps futile to provide any but the most general observation. The question in each case is a factual one of determining the extent of testing required, taking into consideration such noted factors the nature and complexity of the invention, the environment of its intended use, the state of the art at the time the tests were performed.

Of these factors it is the space environment that presents some of the most unique problems under the law of reduction to practice. It is useful in considering this environment to make a distinction the earth's atmosphere, or an airspace environment, and the environment of outer space. Significant parameters in the airspace environment are temperature, pressure, density, composition and wind structure as a function of altitude.[19] The earth's atmosphere effects every space vehicle passing through it by the drag force exerted and subjects the vehicle to dynamic heating and pressure. When the vehicle is in orbital or space flight some of the environmental factors encountered are space vacuum, solar radiation, the black infinite heat sink of outer space, earth radiation and albedo, radiation belts and solar flares, weightlessness and meteroids. In this environment physical-chemical reactions as may be produced by radiation, the evaporation of metals and lubricants, cold-welding and other phenomena cannot be overlooked. In addition, there are operational factors which may be considered environmental conditions for the purpose of ascertaining the intended functional setting of the invention, such as cyclic variations of temperature extremes, separation and despin of the spacecraft from the launch vehicle, attitude control, engine restart and vibration, magnetic torquing and damping. Consideration should also be given to the environmental conditions imposed by prelaunch activities, powered launch, re-entry into the earth's atmosphere, and planetary landing and dwell if such conditions are part of the intended use of the invention.[20]

The state of the art and the relative difficulty of simulating the essential environmental conditions must also be considered. Of probative value is whether one skilled in the art would accept a particular test as showing the invention would perform in the environment intended with a reasonable probability of success. In arts not fully developed in the sense there is not adequate experience to draw upon, as may be the case for inventions advance the state of the art of space flight, which the predictable probability of success is materially reduced unless the test conditions simulate or duplicate the essential conditions encountered in actual use. As knowledge and experience in an art develops it becomes easier to show reduction to practice in that confidence in test procedures is gained, and also because techniques for simulating essential environmental factors will be developed. Experience is being gained daily in simulating the space vacuum and thermal conditions, solar radiation, albedo and planetary radiation, energetic particles, solar wind and solar flares, and other environmental conditions encountered in space. With each successful launch the predictable probability of the successive launch is greater. While exact duplication of the total space environment is not feasible because of economic, technological and terrestrial limitations, operation of a complete spacecraft system under certain simulated space environments has proved highly effective in detecting problems on both prototypes and flight units. Satellites tested in this manner have been very successful in space.[21] In addition, if it can be shown that certain conditions encountered in space are immaterial as far as the operation or intended results of the invention are concerned, they need not be simulated. On the other hand, difficulty or impossibility of conducting tests under actual conditions of use does not alleviate the requirement for testing a complete, operative embodiment to show reduction to practice.[22]

In considering the nature and complexity of the invention one broad distinction that may be helpful is whether the invention is merely intended to be carried to a more hostile environment than ordinarily encountered in the laboratory, or is intended to act on and control the spacecraft. Inventions of this former type may include, for example, electronic packages such as command receivers and computing modules, and certain

auxiliary equipment such as antenna arrays. Such inventions may be used in such a manner that they are not influenced by, or are protected from, many of the conditions of outer space. It may not be too difficult to simulate the essential environmental conditions that do exist in the laboratory, and standard testing techniques or significant experience may be available to establish a relationship between the test conditions and the intended functional setting of the invention such that bench testing that does not duplicate all conditions of actual use may be relied on. For example, temperature may be the only essential environmental condition for a micrologic circuit and it can be readily simulated in the laboratory; or, if the effect of temperature on the parameters of individual components of the circuit is known and the circuit is of a nature that there is no undue interaction of changing component values, it may be possible to reduce the invention to practice without actually duplicating the temperature expected to be encountered in outer space. Similarly, for an antenna array measured radiation patterns in the laboratory may be sufficient to show reduction to practice, perhaps taking into consideration the influence of the effective ground plane of the spacecraft and the doppler caused by spacecraft motion. Generally, as to inventions merely intended to be carried to a more hostile environment by the spacecraft, the guidelines appliable to bench testing as found in existing case law are applicable.

It should also be noted that inventions of the above type may often have other terrestrial utility, and if the claims are not limited to a specific space use tests to establish any practical use reasonably apparent at the time of testing may be relied on. On the other hand, if no utility is apparent other than space use, and such was clearly intended in the time of testing, reduction to practice must be predicated on that use even though the claims themselves are not so limited.

As to inventions intended to act on and control a spacecraft, for example, a stabilization system or the essential sub-components thereof, it is questionable whether bench tests which do not simulate all the essential conditions of intended use may be relied on to show reduction to practice. Inventions of this type are more likely to be influenced by, and are often operable to coact with or to overcome the environmental conditions that are found in outer space, and it may be necessary to simulate these conditions to show that the invention worked as intended in practical use. Testing is also made more difficult by the fact the effects of many of the conditions are interdependent and cumulative. Unless there are standard bench tests either known by experience or established and shown by the evidence to be correlatable with the results obtainable in actual use, it is open to question that a court will accept any testing short of simulated environmental testing for inventions of this nature.

There are no decisions directly on point. The Board in the Rosen et al case found it unnecessary to decide whether tests under conditions of actual service were necessary in that the testing that was in fact performed was found to be deficient in other respects.[23] Also of interest is a series of CCPA decisions relating to inventions intended to be used on aircraft.[24] In each of these cases the invention was not tested under conditions under actual flight conditions, nor was it tested under any simulated flight conditions expected to be encountered in actual use. It was found in all of these cases that the laboratory testing actually performed was insufficient to constitute a reduction to practice. Before drawing too close an anology here it is observed that depending on the nature of the particular invention, the rigors of flight within the earth's atmosphere may be greater than those encountered in outer space.[25]

Thus as to inventions intended to operate on and control a spacecraft, as distinguished from those merely carried to a more hostile environment by the spacecraft, one can be sure that the courts will find a reduction to practice only if testing is performed under conditions of actual use or by environmental testing which simulates all the essential conditions of actual use. Whether or not the courts will go further and accept bench testing which does not fully simulate each and every condition of actual use is probabimatical, and if tests of this type are acceptable it is open to conjecture what evidence is necessary to establish a relationship between the test conditions and the intended functional setting of the invention required for a reduction to practice.

REDUCTION TO PRACTICE IN SPACE

Apparent from the foregoing is the fact that situations will arise where the requirements for testing either have not been or cannot be complied with on earth, and reduction to practice must necessarily be shown by successful operation of the invention in outer space. Patent laws do not have extra-territorial effect; that is, except for certain priority rights not relevant here the local law of the country in which the application is filed governs the perfecting of the rights.[26] As has been previously noted, under the patent laws of this country the date of the invention cannot be established by relying on acts in a foreign country. The practical results of this is to limit proof of actual reduction to practice to acts occurring in the United States. As stated in the Rosen et al case:

> Aside from the important question of whether it occurred in the United States, the successful use of the velocity control [producing orbital maneuvers] would constitute a reduction to practice (emphasis and bracketed material added).[27]

The tacit assumption is that reduction to practice must have occurred within the jurisdiction of some country, and if that country cannot be shown to be the United States it must have been a foreign country.

It is generally agreed today that each nation is sovereign over the airspace above its territorial boundaries except as may be limited by international agreement.[28] Outer space, by current agreement among nations is free to all[29] and is not subject to claim to national sovereignty.[30] The air space above the high seas is free to all and not subject to sovereign control by any one nation. Current discussions are directed to the problem of establishing the demarcation between airspace and outer space; that is, ascertaining just how far up, or out, the airspace sovereignty of a nation

extends.[31] For the purposes of the present discussion the concern is with the operation of an invention carried onboard a spacecraft beyond any established boundary between airspace and outer space, and the specific issue of whether such operation is an activity that can be relied on to establish a reduction to practice of an invention within the context of the United States patent laws.[32]

A. The Integrated Instrumentality

The only reported decision concerning reduction to practice of an invention in orbital flight is the above-mentioned Rosen et al case, where the Board of Patent Interferences held that successful orbital maneuvers of the spacecraft utilizing the invention in question did in fact constitute a reduction to practice in the United States.[33] In reaching this conclusion the Board stated:

> we are inclined to view the operation of the integrated instrumentality including parts of the satellite and its control point, the latter being in the United States, as not being removed from the United States by reason of the satellite being necessarily distant from the several states of the United States (emphasis added).[34]

The "control point" included ground equipment for receiving information telemetered from the satellite, and for initiating the command pulses to the satellite for performing orbital maneuvers. It also included apparatus at the control point and elsewhere throughout the world, onboard ship, or otherwise under United States jurisdiction, for obtaining range and range rate information to determine when certain orbital maneuvers were to be performed and to provide an indication that the maneuvers were successfully performed. Without the various apparatus located at the control point and elsewhere within the jurisdiction of the United States it would have been impossible to operate the invention or to obtain any evidence that it had in fact operated successfully.

There are many inventions carried onboard spacecraft, especially in unmanned craft, that operate only in response to commands eminating from the United States. In addition, other equipment located within the jurisdiction of the United States, including tracking equipment, telemetry and command apparatus and computing complexes, is necessary for receiving and evaluating information showing the performance of the invention. This equipment, all or part of which may be considered a control point, is the only means available to initiate operation of the invention and to provide data to establish that in fact it has operated successfully. As to such inventions reduction to practice may be based on the concept of the operation of integrated instrumentality, not being removed from the United States by reason of the spacecraft being necessarily distant.

A control point in the Rosen et al case was included as part of the claimed combination, and this raises a further question of whether the courts would also apply the integrated instrumentality concept to find a reduction to practice of an invention where the control point and/or related apparatus was not part of the claim combination. In suggesting an answer it is noted that in most instances the telemetry command signals sent to the spacecraft are the only means by which the invention may be operated, and the related equipment the only means to ascertain where the spacecraft is and when to operate the invention. The information subsequently received from the spacecraft and processed through the control point constitutes the only evidence to prove the invention operated successfully in its intended functional setting. All this represents activities within the United States. The spacecraft itself, in keeping with the present concepts of space law, is not under the jurisdiction of any foreign country. The only activities here on earth having any substantial contact with the operation of the invention, and the only evidence available to prove reduction to practice, most necessarily be found in the United States. As has been discussed, the geographical constraints imposed by the patent statutes are for uniformity of practice and procedural convenience.[35] An important consideration here is the availability of the evidence and convenience of proof, and where the only evidence is obtained from a control point in the United States these geographical constraints are deemed inapplicable. It is therefore submitted that as to any inventions carried onboard spacecraft operated by and under the control of command signals originated from the United States, with information evidencing the operation being received and processed in the United States, such inventions may in fact be considered to be reduction to practice in the United States.

B. A Free Space Concept

The Treaty on Outer Space[36] and the United Nations Resolution 1962[37] provide that "states on whose registry an object launched into space is carried shall retain jurisdiction and control over such objects and any personnel thereon while in outer space." A nation that constructs and orbits a spacecraft, manned or unmanned, retains ownership and control over it no matter where it is located. A spacecraft may come under American registry in the same sense as the registry of an ocean going vessel.[38] The jurisdication and control of the states under whose registry the spacecraft is carried clearly includes the applicability to the spacecraft and occurrences thereon the law of the state of registry in the same manner in which occurrences onboard a ship are governed by law of the flag.[39] The anology between space law and the law of the high seas of many purposes is an obvious one.[40]

The courts have had occassion to discuss occurrences on a ship on the high seas in regards to the patent laws:

> The patent laws of the United States afford no protection to inventions beyond or outside the jurisdiction of the United States; but this jurisdiction extends to the decks of American vessels on the high seas, as much as it does to all the territory of the country, and for many purposes is even more exclusive.[41]

It is submitted that whenever the United States constructs and orbits a spacecraft, any legally relevant events, such as the operation and testing of an invention in its intended functional setting, comes within the jurisdiction of the United States and as such the invention may be considered as being reduced to practice in the United States under patent law.

CONCLUSION

It is concluded that space inventions, many of which represent enormous expenditures on both the part of private industry and the government, are subject to the same basic considerations in regards to the requirements for testing as terrestrial inventions for the purpose of establishing reduction to practice. Intended operation of the invention in a space environment may impose more stringent requirements for testing, but does not prevent the invention from being reduced to practice on earth rather than under actual service conditions in space. The requirements will be greater for inventions intended to act on and control a spacecraft in a space environment than for those merely carried to a more hostile environment by the spacecraft.

If the requirements for testing have not been or cannot be complied with such that reduction to practice must necessarily be shown by operation in outer space, the invention can be considered to have been reduced to practice in the United States under one of two theories. Firstly, although an invention is carried on a spacecraft remote from the United States, it may be operated by and under the control of command signals originating from the United States, and accordingly, may be considered as an integrated instrumentality not being removed from the United States by reason of the spacecraft being necessarily distant. Secondly, for spacecraft operating beyond sovereign airspace, a free space doctrine may be applied. Here legally relevant events, such as reduction to practice, come under the jurisdiction of the launching or registry nation analogous to the manner that jurisdiction extends to the decks of vessels on the high seas.

FOOTNOTES

1. Conditions for patentability are set forth in 35 U.S.C., Sections 102 and 103:

   §102 – conditions for patentability; novelty and loss of right to patent;

   A person shall be entitled to a patent unless–

   (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

   (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

   (c) he has abandoned the invention, or

   (d) the invention was first patented or caused to be patented by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application filed more than twelve months before the filing of the application in the United States, or

   (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or

   (f) he did not himself invent the subject matter sought to be patented, or

   (g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

   Notes–Section 4(b) of the Act of July 19, 1952 provides:

   "Section 102(d) of Title 35, as enacted by section 1 hereof, shall not apply to existing patents and pending applications, but the law previously in effect, namely the first paragraph of R. S. 4887 (U.S. Code, title 35, sec. 32, first paragraph, 1946 ed.), shall apply to such patents and applications."

   Section 4(d) of the Act of July 19, 1952 provides:

   "The period of one year specified in section 102(b) of Title 35 as enacted by section 1 hereof shall not apply in the case of applications filed before August 5, 1940, and patents granted on such applications, and with respect to such applications and patents, said period is two years instead of one year."

   §103 – conditions for patentability; non-obvious subject matter

   A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Most corporate employees assign their patent rights to their employer; recognition is received through the employer's patent awards program and from the fact that the patent issues in the inventor's name. The same is generally true for DOD contracts where the government is granted a license. Title is in the government for inventions made under NASA contracts, and unless it is waived the application is filed by, and issues in the name of, the Administrator.

3. For contracts relating to space activities NASA and DOD are the principal government agencies, and Comsat Corp. perhaps the only private company to consider. NASA takes title to inventions made under contract pursuant to Section 305 of the NAS Act of 1958 (42 U.S.C. 2457), as implemented by

the NASA Procurement Regulations, 9-101. There is no statute covering property rights in inventions for DOD contracts; generally title remains in the contractor with a license to the government, with some exceptions, as set forth in the Armed Services Procurement Regulations, 9-107. Particular attention is given to contracts relating to space activities in 9-107.9, giving the government the right to license others for inventions relating to communication satellites. Rights to inventions made under contracts with Comsat Corp. are, of course, a matter agreement between the parties; however, Comsat Corp. has used a title clause in some instances.

4. See Grauer, "The Legally Complete Invention – A Study of the Requirement of Testing to Establish an Actual Reduction to Practice," The George Washington Law Review, Vol. 33, March, 1965, pp. 740-763 for a comprehensive summary of the requirement to establish an actual reduction to practice. Of significance is the fact that Sections 102(a), (e), and (g) of the patent statute make the date of invention, rather than the filing date of the application, the crucial date.

5. 1 Walker, Patents §45 (Deller 2d ed. 1964).

6. Morse v. Porter, et al, 155 USPQ 280, 283 (PO Bd. Pat. Inter, 1965):
   In patent law an invention comes into being when it is reduced to practice.
   Rosen et al v. National Aeronautics and Space Administration, 152 USPQ 757, 765 (PO Bd. Pat. Inter, 1966):
   Conception must be of an operative invention as it is thereafter to be applied in practice . . . an actual reduction to practice of an invention requiring tests must be established by demonstration in fact as distinguished from a demonstration in theory.

7. Under certain circumstances an applicant may benefit from a constructive reduction to practice, that is, the filing of a patent application that fully discloses the invention as required by 35 U.S.C. 112. In government contracting the term "made" as applied to a subject invention is defined as conception or first actual reduction to practice, thus excluding consideration of constructive reduction to practice. For the purposes of this discussion consideration is given only to an actual reduction to practice.

8. 35 U.S.C. 104:
   In proceedings in the Patent Office and in the courts, an applicant for a patent, or a patentee, may not establish a date of invention by reference to knowledge or use thereof, or other activity with respect thereto, in a foreign country, except as provided in section 119 of this title. Where an invention was made by a person, civil or military, while domiciled in the United States and serving in a foreign country in connection with operations by or on behalf of the United States, he shall be entitled to the same rights or priority with respect to such invention as if the same had been made in the United States.

9. Eli Lilly and Co. v. Brenner, 147 USPQ 442, 469 (D.C.D.C. 1965), referring to comments on Congressional intent found in Monaco et al v. Hoffman et al, 189 F. Supp. 474, 127 USPQ 516 (D.C.D.C. 1960).

10. The cases on reduction to practice are legion. Among the more recent ones by the Court of Customs and Patent Appeals (CCPA) dealing with the requirement of testing are: Elmore v. Schmitt 278 F. 2d 510, 125 USPQ 653 (1960); Paivinen v. Sands, 339 F. 2d 217, 144 USPQ 1 (1964); White v. Lemmerman, 341 F. 2d 110, 144 USPQ 409 (1965); Knowles v. Tibbetts, 146 USPQ 59 (1965); Gordon v. Hubbard et al, 146 USPQ 303 (1965).

11. Mason v. Hepburn, 13 App. D. C. 86 (D. C. Cir 1899); Sydeman v. Thoma, 32 App. D. C. 362 (D. C. Cir. 1909); Sachs v. Wadsworth, 48 F. 2d 928, 9USPQ252 (CCPA 1931) (Switchbox lid); Olson v. Thompson, 77 F. 2d 104, 25USPQ388 (CCPA 1935) (lock washer).

12. Birmingham v. Randall, 171 F. 2d 957, 80 USPQ 371 (CCPA 1949).

13. Supra note 10.

14. Supra note 4, at 753, commenting on Elmore v. Schmitt, supra note 10. See also Paivinen v. Sands, supra note 10, at 9, and White v. Lemmerman, supra note 10 at 411, 412.

15. Elmore v. Schmitt, supra note 10, 278 F. 2d at 513, 125 USPQ at 656; Radio Corp. of America v. Philco Corp., 154 USPQ 570, 599 (D. C., D.N.J. 1967).

16. Bell Aerosystems Company, Division of Bell Aerospace Corp., 67-1BCA6203. The invention involved a manned rocket lift device.

17. Rosen et al v. NASA, supra note 6. The invention was for the pulsed-jet velocity control system used for station-keeping of the SYNCOM communications satellite.

18. Id. at 762.

19. "The Space Environment," reprinted from "Data Book for Environmental Testing and Spacecraft Evaluation," prepared by Test and Evaluation Division, GSFC.

20. New, John C., "The Dynamic Environment of Space," GSFC Report X-320-62-166, Sept. 25, 1962.

21. New, John C., "Experiences in Simulating The Space Environment for Scientific Satellites," GSFC Report X-320-64-361, July 1964.

22. Rosen et al v. NASA, supra note 6, at 764:
   However, we have here no such previously accepted practice for testing apparatus for changing the linear velocity of a spinning body; the art of satellites was admittedly in its infancy. Accordingly,

we believe that these cases do not excuse Petitioners from testing the complete system defined in the counts as a combination, to establish reduction to practice.

23. Rosen et al v. NASA, supra note 6, at 765. The invention involved may be catagorized as one intended to act on and control the spacecraft.

24. Powell v. Poupitch, 167 F. 2d 514, 77 USPQ 379 (CCPA 1948) (cowling fastner); Burns v. Curtis, 172 F. 2d 588, 80 USPQ 587 (CCPA 1949) (fuel pump); Balogh v. Crot, 176 F. 2d 923, 83 USPQ 130 (CCPA 1949) (flexible joint for high pressure fluid lines); Chandler v. Mock, 202 F. 2d 755, 97 USPQ 135 (CCPA 1953) (carburetor for aircraft engines); Gaiser v. Linder, 253 F. 2d 433, 117 USPQ 209 (CCPA 1958) (coating for aircraft windshields to prevent icing).

25. Cases by other tribunals dealing with related subject matter are: Radio Corp. of America v. International Electric Corp. 232 F. 2d 726, 109 USPQ 228 (CA 3rd Cir. 1956) (radar system and indicator, no reduction found); Kearfott Div. of General Precision, Inc. 61-2BCA 3241, (ASBCA 1961) (gyro reference system, reduction found); Doak Aircraft Co., Inc., 1963BCA-3684 (ASBCA 1963) (flight control system, no reduction found); Farrand Optical Co. v. United States, 325 F. 2d 328, 139 USPQ 249 (CA 2d Cir. 1963) (optical system for bombsights, reduction found). See also Bell Aerosystems Co., note 6 supra (manned rocket lift device, no reduction found) and White v. Lemmerman, note 10 supra (floated gyro, no reduction found).

26. 35 USC 119, providing for a priority date based on the filing of an application in a foreign country under certain circumstances.

27. Rosen et al v. NASA, supra note 6, at 766.

28. Haley, Space Law and Government 40 et seq. (New York, Appleton-Century-Crats 1963).

29. United Nations Resolution 1962 (XVIII) December 13, 1963 (para. 2) provides:
> outer space and celestial bodies are free for exploration and use by all States on a basis of equality in accordance with international law.

Article I of the Treaty on Principles Governing the Activities of States in The Exploration and Use of Outer Space (to which there are 82 signatories including the United States) also recognizes the international nature of space activities and assures freedom and equality in space exploration.

30. The U.N. Resolution (para. 3) provides:
> outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by other means

Article II of the Treaty on Outer Space contains essentially the same wording.

31. Haley, supra note 28, 75 et seq. See also Doyle, "When a Lid On National Sovereignty?", Astronautics and Aeronautics, Oct. 1967, 94, 95.

32. It is not unreasonable to postulate that the demarcation will be established by a band or zone. This raises further questions as to the status of inventions intended to operate within such a zone; for example, on a craft such as the X-15 or in conjunction with the re-entry of a spacecraft.

33. Supra note 6, at 768. At the time the orbital maneuvers were performed the satellite was in a nearly synchronous orbit over South America and the Atlantic Ocean.

34. The basis for this concept of an integrated instrumentality was found in prior Interference No. 84, 143, reversed on other grounds. Alford v. Loomis, 252 F. 2d 571, 117 USPQ 29 (CCPA 1958). The invention involved a beacon navigation system, and the testing relied on for reduction to practice included stations located in Canada, established and initially operated by an agency of the United States and by intergovernmental agreement.

35. Supra note 9, at 469.

36. Article VIII.

37. Para. 7.

38. Analysis of Treaty, Article VIII, Staff Report, Committee on Aeronautical and Space Sciences United States Senate, GPO March 1967.

39. JENKS, SPACE LAW 238 (New York: Frederick A. Praeger, 1965).

40. For further discussions on space law, with particular reference to the law of the high seas, see: Horsford, "The Law of Space," Journal of the British Interplanetary Society, May-June 1955, pp. 144-150; Ward, "Projecting the Law of the Sea into the Law of Space," The JAG Journal, March 1967, pp. 3-8; Hildred and Tymms, "The Case Against National Sovereignty in Space," The Aeroplane (London), May 23, 1958, pp. 712-713; Heinrich, "Air Law and Space, Saint Louis University Law Journal, Sprint 1958, pp. 11-69.

41. Justice Clifford in Gardiner v. Howe, 9 Fed. Cases 1157.