CA 345/87

and Cross-Appeal

Hughes Aircraft Company
v.
1. The State of Israel
2. Kaiser Aerospace & Electronics Company

In the Supreme Court Sitting as a Court of Civil Appeals
[July 2, 1990]
Before Shamgar P., Barak J., and Bach J.

Editor's synopsis –

Appellant, the Plaintiff in the District Court below, sued the Respondents for infringement of a Patent owned by it, which concerns optical display systems utilizing holographic lenses. Respondent 1, the State of Israel, had ordered from Respondent 2, Kaiser Aerospace & Electronics Co., the manufacture and installation in certain aircraft of head-up display systems (HUD), which the Appellant contended infringed its Patent.

The HUD is an information display system installed in the airplane's cockpit that displays information to the pilot concerning the flight, firing and direction of armaments, radar picture, view of enemy aircraft, and the like. Normally, the pilot obtains such information by reading the various dials and other displays in front of him. The HUD displays this same information on the aircraft's windscreen, facing the outside world. The pilot can read the information without lowering his head toward the dials, while he is watching the outside world, with consequent significant advantage, especially in the case of military aircraft.

The Respondents defended against the Appellant's suit in the District Court on three grounds. First, they denied that they infringed the Appellant's Patent. Second, they contended that the Patent was invalid, arguing that the invention was not novel when it was patented, that it did not constitute an inventive step and that the Description of the invention in the Patent was insufficiently precise. The Respondents' third defense was that they were the beneficiaries of a license granted by the Appellant to the United States government.

The lower court held in favor of the Appellant that the invention was patentable, in that it satisfied the requirements of novelty and inventive step and that the Description was adequate. It also ruled in favor of the Appellant that the Respondents are not beneficiaries of the license granted by the Appellant to the United States. However, it decided the case against the Appellant on the ground that the Respondents had not infringed the Patent, based on its determination of the scope of the Patent as set forth in the Patent Claims filed by the Appellant.

The Appellant appealed this decision to the Supreme Court which, sitting as a court of appeals, reversed the lower court's judgment, in an opinion written by the President, and entered judgment in the Appellant's favor. The Supreme Court ordered the Respondents to abstain from infringing the Patent and returned the case to the District Court to hear evidence concerning the issue of damages. Among the various points of law passed on by the Supreme Court, it held that -

1. If the inventor wants to link a Patent to a specific result, he must claim that result in the Claims section of the Patent. The elements included in a combination patent must also appear in the Claims. In a patent limited by result, the result is one of the components of the invention so the inventor must claim protection for it in the Claims.

2. A Patent should be interpreted as an entirety. Although the patentee may not rely on the Description to claim a monopoly, and what is not included in the Claim is not included in the monopoly, the meaning of the Claim should be interpreted in light of that which is contained in the Description and accompanying drawings. This is so also when the Claim appears to be unambiguous on its face.

3. Even if the Respondents in this case did not infringe the Patent literally, they took the substance of the Appellant's protected invention.

4. The patentee bears the burden of proof on the issue of infringement of the Patent. On the issue of its validity, once registered, the burden of proof is on the party that denies its validity.

5. One may not piece together a claim of non-novelty by combining that which is contained in several earlier documents, unless such combination was obvious and would have been apparent to a person skilled in the an at the time the Patent was issued. The information in the public hands must have been sufficient to enable it to perform the invention. If performing the contents of the prior publication, in light of the knowledge possessed at the time by one skilled in the relevant art, constitutes an infringement of the Patent, then the invention is not novel.

6. The requirement of an inventive step is wider than the requirement of novelty. The invention must also make a material contribution to the field. In judging this issue, one must examine the total an in the field. One may put together different documents, if such joining would have been obvious to a skilled person at the time. On the other hand, the inventive step may consist of the very joining together of such different documents, when such combination was not previously apparent to a skilled person.

7. The skilled person to whom these tests are addressed is the average man of the art. He may be art individual or a team familiar with the field, that will be called upon to solve the difficulties on which the dispute revolves.

8. Various subordinate tests have been developed for judging the issue of inventive step, including: whether the invention satisfies a "long-felt need", if it meets with commercial success arising from the advantages of the invention rather than from external market forces, and the reaction of professionals in the field. An invention that satisfies a long-felt need may be art inventive step even if it does not meet with commercial success.

9. The purpose of the requirement of sufficiency of the Description is to ensure that the inventor actually had the invention at the time of the application and to inform the public how to perform it, so as not discourage further research in the field and to allow others its lawful use. The sufficiency of the Description is tested against the general professional knowledge existing in the relevant field at the time of the application. The inventor should include in the Description the data which will allow persons skilled in the art to perform it, without requiring of them any inventive step. This does not preclude the possibility of some trial and error, not exceeding that which is reasonable in the circumstances.

Israel Supreme Court Cases Cited:

[1] C.A. 314/77*, L. M. Lipsky Ltd. v. Manor,* 32(1) P.D. 205.

[2] C.A. 433/82, *Bachri v. Padlon,* 39(3) P.D. 533.

[3] C.A. 700/78, *Issesco, The International Co. for Solar Energy Systems Ltd. v. Banit,* 34(1) P.D. 757.

[4] C.A. 244/72*, Plantex v. The Wellcome Foundation Ltd.,* 27(2) P.D. 29.

[5] C.A. 665/84, *sanopy Ltd. Unifarm Ltd.,* 41(4) P.D. 729.

[6] C.A. 75/55, *"Dong-Or" Ltd. v. Aktiebolaget Sievert & Fornander,* 10 P.D. 1990.

[7] C.A. 528/61, *Greenblad v. "C-B"Ltd.,* 16 P.D. 2490.

[8] F.H. 20/85, *Bachri v. Padlon,* 39(4) P.D. 463.

[9] C.A. 118/51, *New Zealand Insurance Co. Ltd. v. Yuval, 7* P.D.518.

[10] C.A. 367/68, *Mahlev v. The Heirs of the Deceased Aaron David Levy,* 22(2) P.D. 606.

Israel District Court cases Cited:

[11] C.F. (TA) 2051/69, *Inteco Establishment v. Sepeca,* 79 P.M. 240.

[12] C.F. (TA) 1290/57, *American Cyanamid Co. v. Laftit S.P.A.*, 42 P.M. 109.

American Cases Cited:

[13] *Autogiro Company of America v. United States,* 384 F.2d 391 (1967).

[14] *United States v. Adams,* 383 U.S. 39 (1966).

[15] *Graver Tank & Mfg. Co. v. Linde Air Product Co.,* 339 U.S. 605 (1950).

[16] *Nelson v. Batson,* 322 F.2d 132 (1963).

[17] *Anderson's Black Rock v. Pavement Salvage,* 396 U.S. 57 (1969).

[18] *W.L. Gore & Assoc. Inc. v. Garlack, Inc.,* 721 F.2d 1540 (1983).

[19] *Graham v. John Deere Co.,* 383 U.S. 1 (1966).

[20] *Photo Electronics Corp. v. England,* 581 F.2d 772 (1978).

[21] *Diamond Rubber Co. v. Consolidated Tire Co.,* 220 U.S. 428 (1911).

[22] *In re Piasecki, 745* F.2d 1468 (1984).

[23] *Pauduit Corp. v. Dennison Mfg. Co., 774* F.2d 1082 (1985).

[24] *Falkenberg v. Bernard Edward Co.,* 175 F.2d 427 (1949).

[25] *Re Napuin,* 398 F.2d 863 (1881).

[26] *Webster Loom Co.* v. Higgins, 105 U.S. 580 (1881).

[27] *Brooks v. Jenkins, 3* McLean 432 (1944).

[28] *In re Sherwood,* 204 U.S.P.Q. 537 (1980).

[29] *Mine Safety Appliances Co. v. United States,* 364 F.2d 385 (1966).

English cases cited:

[30] *British Thompson-Houston Co. Ltd. v. Corona Lamp Works Ltd.,* (1922) 39 R.P.C. 49 (H.L.).

[31] *Catnic Components Ltd. v. Hill & Smith Ltd.,* [1981] F.S.R. 60 (H.L.).

[32] *British United Shoe Machinery Co. Ltd. v. A. Fussel & Sons Ltd.,* (1908) 25 R.P.C. 631 (C.A.).

[33] *Rosedale Associated Manufacturers Ltd. v. Carlton Tyre Saving Co. Ltd.,* [1960] R.P.C. 59 (C.A.).

[34] *Electric & Musical Industries Ltd. and Boonton Research Co. Ltd. v. Lissen and another,* (1939) 56 R.P.C. 23 (H.L.).

[35] *Clark v. Acke,* (1877) 2 App. Cas. 315.

[36] *British-Thompson Houston Co. Ltd.; Marconi's Wireless Telegraph Co. Ltd. and Electric and Musical Industries Ltd. v. Guieldford Radio Stores and E.K. Cole Ltd.,* (1938) 55 R.P.C. 71 (C.A.).

[37] *No-Fume Ltd. v. Frank Pitchford Co. Ltd.,* (1935) 55 R.P.C. 231

[38] *Poseidon Industry A.B. and others v. Cerosa Ltd.,* [1982] F.S.R. 209 (C.A.).

[39] *In the Matter of Klaber's Patent,* (1906) 23 R.P.C. 461 (H.L.).

[40] *Williams v. Nye,* (1890) 7 R.P.C. 623 (C.A.).

[41] *British Celanese, Ltd. v. Courtaulds Ltd.,* (1935) 52 R.P.C. 171 (H.L.).

[42] *General Tyre & Rubber Co. v. Firestone Tyre & Rubber Co. Ltd.,* [1972] R.P.C. 457 (C.A.).

[43] *British Westinghouse Electric and Manufacturing Co. Ltd. v. Braulik,* (1910) 27 R.P.C. 209 (C.A.).

[44] *Edison & Swan Electric Co. v. Holland,* (1899) 6 R.P.C. 243 (C.A.).

Dr. A. Goldenberg, T. Band, R. Luthi, and S. Kolb - for the Appellant (the Respondent in the Cross-Appeal);

A. Gabrielli and A. Levitt - for the Respondents (the Appellants in the Cross-Appeal).

JUDGMENT

Shamgar, P.: General

1. This is an appeal against the judgment of the District Court in Tel Aviv-Jaffa, in the matter of a claim of patent infringement, as well as against the decision of the aforesaid Court in a motion to correct an error in the aforesaid judgment. A counter-appeal was submitted by the Respondents concerning the lower court's ruling that each party shall bear its own costs.

2. The Patent forming the subject-matter of the hearing is Patent No. 48719 and it concerns "optical display systems utilizing holographic lenses". The Appellant filed an application to register the Patent in Israel, in which it claimed a privilege under the Paris Convention on Protection of Intellectual Property (1884) pursuant to an application

which was filed in the United States on 23.1.1975. The Patent was entered in Israel on 31.7.1977 and was granted on 1.11.1977.

In February 1984, the Appellant filed a claim based on the grounds of infringement of the Patent, and in April of that year it filed a petition for a temporary injunction against Respondent 2 and for a declaratory order against the State. Counsel for the parties accepted the lower court's suggestion to hear the main claim directly, in which they sought a permanent injunction against Respondent 2, an order requiring the Respondents to submit reports, a declaration against Respondent 2 and the award of monetary relief.

As is evident from the statements of the lower court, by the time of the hearing before it, Respondent 2 had not yet manufactured the head-up display (abbreviated to and hereinafter "HUD") forming the subject-matter of the dispute. It began to design it following signature of the agreement with Respondent 1. The design was completed in June 1985, and during the hearing before the lower court, Respondent 2 was engaged, as stated in the lower court's judgment, in the preparation of the technical drawings required to manufacture the HUD. The Appellant argued that it is entitled to prevent the manufacture of the HUD and its supply to the State of Israel even before such acts are actually carried out.

3. The Respondents defended against the claim of infringement by way of three lines of defence: First, Respondent l's product does not infringe the Patent. Second, the Appellant's Patent is invalid. Insofar as the second argument is concerned, the

Respondents contended that the invention forming the subject-matter of the Patent was not registrable as a Patent for three reasons: the invention was not novel on the date of appearance of the Patent; the invention did not have an inventive step; and the Patent Specification is insufficent. The third line of defence contends that even if the Patent was infringed and even if it is valid, the Appellant licensed the United States government to utilize the Patent, and this licence also applies to the transaction entered into between the Respondents. By agreement between counsel for the parties, opinions were submitted by six experts - three by each party - in connection with the infringement, the validity and the licence.

4. The lower court rejected the Appellant's claim.

In its judgment, the District Court rejected the Respondents' contentions concerning the Patent's validity and the licence, but allowed the contention that the Patent was not infringed. On this question, to which the lower court devoted the majority of the hearing, the Court ruled that one of the elements listed in Claim 1 of the Patent was not proved with respect to Respondent 2's product, and it was therefore not proved that the Patent was infringed. The Appeal deals principally with this issue. In its Appeal, the Appellant also attacks the lower court's decision, after the issuance of the judgment, upon a motion by the Appellant to amend an error in the judgment. In its opinion, allowing the motion would have required overturning the result which the Court had reached and acceptance of the Appellant's claim.

The Respondents ask that the Court reject the Appeal, both for the reasons contained in the lower court's findings and conclusions and for reasons which the lower

court rejected or did not refer to, this in the event that we allow the Appeal with respect to the lower court's conclusion on the question of infringement. Along with their pleadings against the Appeal, the Respondents filed, as aforesaid, a Counter-Appeal against the lower court's decision on the matter of costs.

Outline of the Proceedings

5. The Appeals will be considered on the basis of the following:

(a) We will first discuss the technical background of the invention that forms the subject-matter of the Patent.

(b) We will then deal with the question of infringement, the answer to which sealed the Appellant's fate in the lower court. If we conclude in our discussion of this question that the lower court was right in its conclusion, we will naturally be exempt from having to discuss the questions of the Patent's validity and the licence. In such event, we will have to resolve the Appellant's attack against the lower court's decision concerning the motion to correct the judgment.

(c) If we conclude that the Patent was actually infringed, we will also discuss the questions of its validity and the licence. The lower court, which as aforesaid ruled that the Patent was not infringed, saw fit to answer these questions as well, albeit briefly.

(d) Finally, if we find no cause to deviate from the lower court's decisions, the question of costs - the subject-matter of the Counter-Appeal - will arise.

The Technical Background

6. The following are the principal data which are relevant to the matter: The Patent that forms the subject matter of these proceedings deals, as aforesaid, with "optical display systems utilizing holographic lenses", or as Claim 1 of the Patent states, "a display system having a holographic lens".

Although the Patent concerns a head-up display system installed in aircraft, nevertheless, from the wording of the Patent it is evident, prima facie, that it applies to any display system utilizing holographic lenses in the manner set forth and described in the Patent, and that the HUD is just one example (albeit the preferred one) of such a system. This is also evident from the description of the Patent (p. 3) and its specification (p. 27), which notes the holographic HUD and another device installed in a helment as preferred examples of the embodiment of the invention.

With regard to the utilization of the HUD in aircraft, the lower court stated:

> "The HUD... is an information display system installed in the cockpit that displays information to the pilot, including: information on the flight (altitude and speed etc.), on firing, direction of armaments, radar picture, view of enemy aircraft, and the like. Normally, the pilot obtains the required information from a series of dials and displays in front of him. By displaying the information on the aircraft's windscreen, facing the outside world, the pilot does not

> have to lower his head toward the dials. He can read the information while he is watching the outside world. This is an enormous advantage to a pilot who must act quickly, respond immediately and work with maximum concentration. Consequently, the HUD became a hit in airplanes in general and in combat planes in particular".

The utilization of the HUD itself was already known several years before the Patent in question came into existence. However, this was a HUD, in various transformations, whose entire operation hinged on conventional optical lenses, which limited the ability to utilize the device and realize its advantages. The development of the holographic HUD was designed to remove these limitations.

In order to understand how the HUD works, we would do well to describe the device's various components, in the words of the lower court:

> "The conventional HUD uses a cathode ray tube ("CRT") similar to that of an ordinary TV set. It would be convenient to use Fig. 15 of the Patent to demonstrate how it works. I will therefore set it forth here:

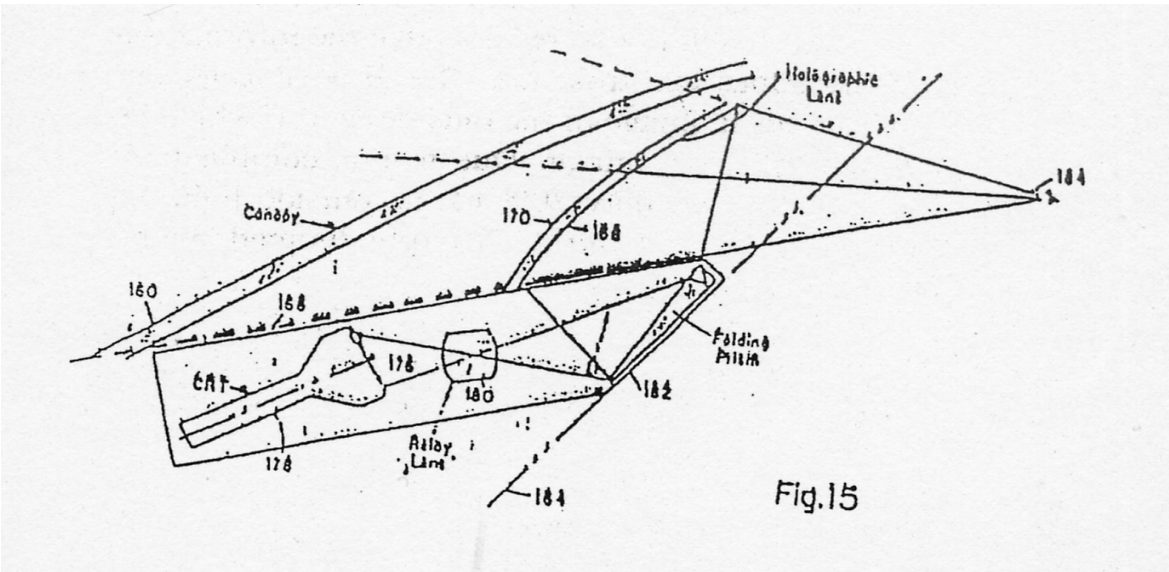


Fig.15

The information which one wants to screen to the pilot is displayed on the CRT (numbered 176 in this drawing) similarly to the manner in which an image is displayed on a TV screen. (The picture appearing on the CRT screen is called the 'object plane' and it is numbered 176 - M.S.). The light emitted by the screen passes through a 'relay lens' (numbered 180 on the drawing), hits the folding mirror (numbered 182 on the drawing) and is reflected to a transparent plate called a combiner (located at number 168 - M.S.). On the way to the combiner, the light rays pass through a 'collimator', which is a lens that converts the beams focused on it to parallel rays. The combiner is located between the (eye of) the pilot at point 184 of the drawing and the aircraft's canopy (numbered 160 on the drawing). The combiner is a plate made of glass, which is partly coated with silver, that acts as a kind of selective mirror. It reflects the light reflected to it from the folding mirror toward the pilot, but it simultaneously acts as a transparent plate through which the pilot can see the outside world. The combiner allows about 30% of the light coming from the CRT to be reflected by the aforesaid mirror horizontally to the

pilot's eyes. The remaining 70% of the light passes through the mirror as if it had passed through ordinary glass and does not reach the pilot's eyes. When the pilot looks at the mirror he can see the 30% of the light from the CRT, although not clearly and strongly and, as stated, he can also see the outside world through it. The result is that the information reaching the pilot's eye from the CRT is visible to him superimposed on an image of the outside world, which he sees through the same mirror. Due to this combination, the pilot actually sees only 70% of the outside light, so his picture of the outside world is slightly dimmed, but on the other hand, he receives the screening of the information superimposed on a picture of the outside world. The combiner, thus, combines the information coming from the CRT and a view of the outside world".

7. The conventional HUD had three main drawbacks:

(a) A narrow Immediate field of view: The display reached the pilot's eye at an angle of about 15-16 degrees, and any movement by him outside this narrow range prevented him from receiving the information through the HUD.

(b) A dim picture of the outside world: Due to the combination of the light coming from the CRT and the outside light, only 70% of the outside light reached the pilot's eye, the effect of which was similar to placing sunglasses on the pilot's eyes, which was a significant limitation, particularly at times or in places of limited visibility.

(c) Glare: The combiner acted as a mirror not only for the light coming from the CRT, but also for light beams coming from other angles and of other colors, which interfered both with the pilot's view of the outside world and with his reading of the information reflected by the combiner.

Beginning at the end of the sixties, various attempts were made to improve the HUD, with the aim of solving the problems described above. The lower court cited, for example, the attempts in this field made by the Farrand and Marconi companies, but they did not go beyond conventional optics, and counsel for the parties were divided as to the degree of success of those attempts.

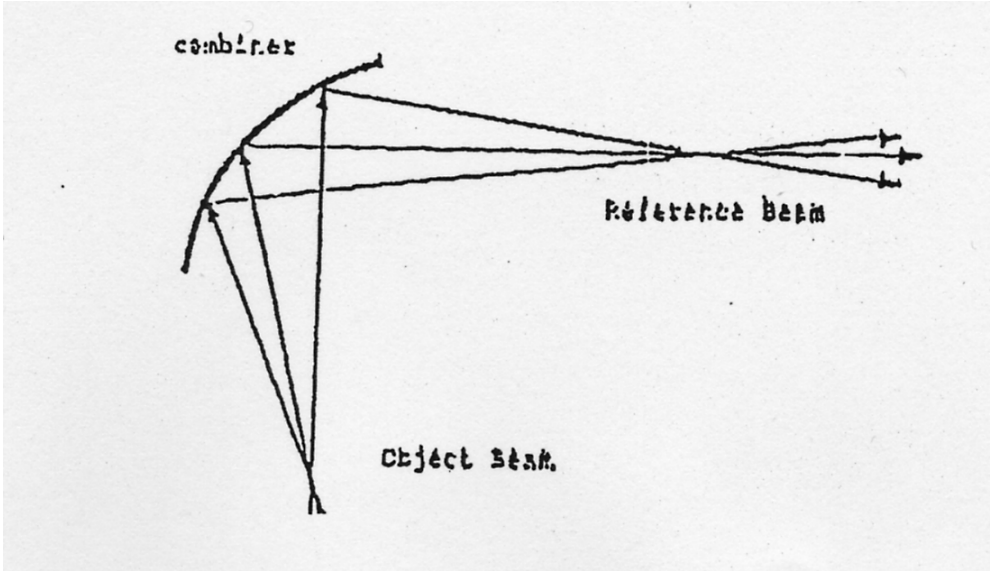
8. Still another attempt to improve the HUD, which is relevant to the present case, sought to go beyond conventional optics and to harness the technique of holography to the HUD. The hologram was invented in 1948 by Dennis Gabor, and to understand its principles and how it works we will rely on the statements of Advocate Gabrielli, learned counsel for Respondent 1, as set forth in the lower court's judgment:

> "The hologram is created by a series of dense lines which are formed on a photosensitive film by two laser beams, which are applied to the film from different directions to form a series of dense lines. The development of this system was known as a hologram. The hologram is able to bend light beams by diffraction. There are two main types of holograms: transmissive and reflective. The first is formed by two laser beams striking the film from the same direction, whereas the second is formed by two laser beams aimed at the film

> from two different directions. Whereas a mirror reflects an image, and a lens works by refraction, a hologram works by diffraction. Each of the above optical effects has the practical effect of repositioning or realigning the light beams".

The harnessing of the hologram for use in the HUD began in the early seventies. In the holographic HUD, the combiner is a hologram (number 168 on the above drawing). The lower court described its operation as follows:

> "The holographic combiner may be considered a selective mirror. It acts as a mirror for light of a certain frequency, i.e. of a certain color, coming from a certain pre-determined angle, and reflects it to a certain pre-determined range. For light of a different frequency, i.e. of a different color, or light coming from a range of different angles, it acts as transparent glass and allows it to pass through without reflecting it. It is made of a material similar to that found on an ordinary photographic film which is applied to a sheet of glass or another transparent base. As stated earlier, two laser beams are reflected onto it, one called the 'object beam' and the other called the 'reference beam'. The following drawing demonstrates these two beams which create the holographic combiner:



After the projection, the transparent plate is developed in the same way as the development of a photographic film, which is how the holographic combiner is formed. When light moves toward the holographic combiner in the same direction as one of the light beams reflected onto it as described above, the light will be reflected back to the original direction of the other laser beam. This is the optimum reflection angle which yields maximum optical efficiency. Light which moves toward the combiner at a substantial deviation from the direction of one of the light beams which were originally reflected will not be reflected at all. Light striking with a small deviation will be reflected, but with inferior optical efficiency. This is called 'angular sensitivity'. As stated earlier, the light striking the combiner is reflected to a specific angular range. The manner in which a person looking at the combiner will see the light reflected from it depends on his position. If he views it from a direction within the range of the angles to which the light is reflected from the combiner, he will see

the light at varying strengths. The more he shifts from the optimum angle of reflection, the weaker the reflected light he will see. If it is viewed from outside the range of angles to which the light is reflected, he will see nothing at all".

9. The holographic HUD was intended to solve the three drawbacks listed earlier, which limited the use of the conventional HUD. The use of a holographic combiner did indeed solve the problem of dimness of the picture. The hologram's selectivity with respect to the various angles from which the light was coming and its various frequencis (i.e. colors) made it possible for almost all the light beams from the outside world to reach the pilot's eye, together with most of the light beams from the CRT screen. This feature of the hologram also eliminated the phenomenon of glare.

As described above, in order to achieve maximum optical efficiency in utilizing the hologram, it was necessary to build it in such manner that the laser beams would be projected onto the surface which was to serve as a holographic combiner in exactly the same angles at which the light would be projected from the CRT screen, until it reaches the pilot's eye. Once the hologram was built in this way, there was formed a kind of imaginary exact route for the information picture, which could "travel", as it were, by the route created when the hologram was built, to arrive in full at the pilot's eye, without any of this light escaping from the hologram to the outside world. On the other hand, light beams from the outside world, arriving in different frequencies and from different directions, were completely unaffected by this imaginary route and passed in their entirety to the pilot. This feature was called a "selective mirror". The technical

terminology for this optimum situation is that the principal beams of the system satisfy the state called the "Bragg condition".

Another important point must be added. As mentioned earlier, the picture coming from the CRT to the combiner is superimposed on the view of the outside world. The pilot's eye cannot focus simultaneously both on the picture of the outside world and on the information picture superimposed on it, because, just like any other lens, the human eye must focus itself according to the distance of the object from it. Since the outside picture reaches the pilot, for focusing purposes, from "infinity", the information picture displayed on the HUD must also come, as it were, from infinity, for the pilot to be able to see it simultaneously and clearly. In terms of optics, this means that the information picture must reach the pilot's eye in parallel light beams.

The two features described above were achieved in the production of the hologram by placing one laser source (the object beam) at the location of the image plane (the CRT screen) and placing the other source (the reference beam) at theoretical infinity. Thus when the combiner is in operation, the light moves from the surface of the image by the imaginary route fixed for it, reaches the pilot in full and is visible to his eye at the exact same focus as the light from the outside world.

10. The manufacturing configuration described above, which the parties called the "conventional configuration", indeed gave the HUD maximum optical efficiency, but it created new limitations for users. First, the considerable angular sensitivity of the hologram narrowed the immediate field of view of the pilot to an even greater extent than that of the conventional (non-holographic) HUD. The effective angle of view of the

information was reduced to l0 to 15 degrees. Second, there arose a problem of aberration of the light beams reaching the pilot from the CRT. This aberration phenomenon distorted the information picture in various ways: instead of a sharp picture, the pilot saw a "comet" or "cloud". Aberrations of various types caused "clouds" of various types. Furthermore, attempts to solve the first problem, i.e. the narrow field of view, exacerbated the problem of optical aberrations, and vice versa.

The Appellant argued that it was the first in the world to deviate from the conventional configuration for construction of the holographic HUD. This deviation allowed it to break out of the circle of inter-relationships between the problems of field of view and aberrations. By means of the deviation, they obtained from the combiner aberrations of a type which could be compensated for by a system of conventional optical relay lenses.

The substance of the Appellant's development was moving the laser sources used to build the holograms from their "traditional" positions - i.e. the image plane and infinity - to other positions, called "entry pupil" and "exit pupil". The exact location of these positions, as well as the definition of the laser sources themselves, will be clarified later.

This manufacturing configuration resulted in a discrepancy between the construction geometry of the hologram and its utilization geometry. The significance of this discrepancy is reflected in a loss of optical efficiency in the area of the center of the image. However, the new construction made it possible for the first time to achieve high optical efficiency with a wide field of view, while obtaining certain aberrations which could be corrected by the relay lens. The professionals called the aberrations which

arose in the system "axial astigmatism" and "axial coma". The former refers to a change in the focal point in the horizontal and vertical directions, and the latter refers to an aberration which causes a sharp image to look like a "comet" at the center of the field of view.

Regarding the deviation from the conventional configuration, I note that there is no dispute that this deviation was already known at the relevant time, so it is not a novelty in the Appellant's Patent. Learned counsel for the Respondent argued that the Appellant presented the deviant technique, in its pleadings and before the lower court, as if it is part of the novelty of the invention. However, a study of the pleadings and of the lower court's judgment shows that no such representation was made, and all that the Appellant stated was that it had developed the new technique, although prior to the Patent.

11. The following are the relevant sections of the Patent:

Claim 1 of the Patent that forms the subject-matter of this proceeding, which as usual is the widest and most encompassing of all the claims, defines the invention that is protected by the Patent as follows:

> "A display system having a holographic lens constructed with two coherent sources located relatively close to entrance and exit pupils thereof, and which deviates the axial ray coming from an object surface through an off-axis angle into an exit pupil and which has a focal surface with axial coma and axial astigmatism, said display system having: first, means along said axial ray between said object

surface and said holographic lens to compensate said axial coma, and second, means along said axial ray between said object surface and said holographic lens to compensate said axial astigmatism."

For the purpose of the hearings, the lower court simplified the wording of the Claim, marking with an asterisk those terms whose interpretation was disputed by the parties:

"The Claim is for a display device with a holographic combiner formed by two laser beams. The sources (*) of these light beams are located relatively close (*) to the places known by the name entrance pupil and exit pupil (*). The holographic combiner causes the light beam which strikes it and which comes from the CRT (i.e. the image plane) to shift, by means of the off-axis angle, into the exit pupil. The combiner has a focal plane which has optical aberrations (*), known as axial coma aberrations and axial astigmatism aberrations. The aforesaid device has means, along the axial beam (between the CRT and the combiner), for compensating these aberrations, one to compensate the coma aberrations, the other to compensate the astigmatism aberrations (*)".

The following extracts from the Specification of the Patent are relevant for our purposes, in addition to the Claims:

"Background of the Invention

1. Field of the Invention

This invention relates to display systems utilizing holographic lenses and more particularly to a display system incorporating a holographic lens constructed with aberrated wavefronts which is used in conjunction with other optical elements including cylindrical, tilted and decentered surfaces to provide correction of the aberrations in the holographic lens.

2. Description of the Prior Art

…

The holographic lens is constructed with coherent sources located close to or at the desired entrance and exit pupil locations of the holographic lens, so that the Bragg condition is met for the chief rays, thus providing a high reconstruction efficiency across a large field of view.

…

Unless compensation is provided for the aberrations in the holographic lens operating at a relatively large off-axis angle, the display provides a very poor image quality that may be unsatisfactory for operations such as helmet-mounted display or aircraft head-up displays.

Summary of the Invention

Briefly, this invention is a display system such as a helmet-mounted display or a head-up display utilizing a holographic lens operating at a relatively large off-axis angle and with a relatively large field of view. The observer looks through the holographic lens at a scene which is a collimated virtual image of an object surface projected through optics including a relay lens. The holographic lens is constructed with aberrated wavefronts to minimize the variation of astigmatism across the field, the aberrated wavefronts being obtained by means such as by placing tilted cylindrical elements in the hologram construction optics. The relay lens may contain cylindrical surfaces which primarily permit the compensation of the axial astigmatism in the holographic lens. The relay lens may also include a prism system, tilted glass plates or lenses, or decentered lenses to compensate for axial coma in the holographic lens.

Objects of the Invention

It is therefore an object of this invention to provide a display system having good image quality over relatively large fields of view and obtained by utilizing a holographic lens in conjunction with other optical elements.

It is another object of this invention to provide a display system in which an image of an object is collimated by a holographic lens to

provide a high quality image of the object located at infinity and clearly viewable by an observer located at the exit pupil of the holographic lens.

It is another object of this invention to provide a high quality display system utilizing a holographic lens operating at a relatively large off-axis angle in conjunction with other optical elements...

It is still a further object of this invention to provide a holographic head-up display that provides good image quality while operating at a relatively large off-axis angle and having a relatively large field of view."

12. The parties also disputed the scope of the Patent before the lower court. Learned counsel for the Respondents (the Defendants in the lower court) argued that the Patent is applicable, if at all, only to correction of the aberrations in the manner mentioned in Claim 1. All the other elements mentioned in the Specification - such as the holographic HUD, the holographic combiner made with aberrated wavefronts, the use of a holographic combiner together with an optical relay comprising tilted and decentered lenses, the use of an optical relay to correct aberrations orginating from the holographic combiner, and the specific aberrations mentioned in Claim 1 - all these, it was argued, were known on the date of filing of the Patent in the United States. This is evident, contends counsel for the Respondents, from the chapter dealing with the "Background of the Invention", a passage from which was cited above.

On the other hand, learned counsel for the Appellant (the Plaintiff in the lower court) argued that the invention refers to a holographic HUD with a wide field of view. The system may well comprise a combination of several components, some of which may have been known previously, but this is a combination patent which was granted for a combination of the assembly of components into a single unit, and we should not break down the invention into its components and distinguish between those which were already known and those which were not. In a combination patent, the invention is embodied in the final combination of several components which gives birth to a whole new system which had never before been made, and which entails an inventive step.

Regarding the mention of the components in the chapter "Background of the Invention", the lower court ruled:

> "If an inventor has claimed in the Specification that certain matters were 'prior art' at the time he prepared the Patent, he cannot claim those matters or any part of them in the Claim. Even if he erred in writing whatever he wrote, he is **bound** by his mistake and we do not have to look at the sources of the prior art to determine whether such matters are actually so or not".

However, the lower court accepted the Appellant's argument that the Patent in question is a combination patent, saying:

> "After reading the Claims, against the background of the Specification, parts of which were cited above, and in view of the

> experts' testimony... I conclude that Claim 1 of the Patent is for the **HUD in its entirety** and not only for the correction of the aberrations mentioned therein. It is true that certain parts and subjects of the HUD were not novel, but were known previously. However, the creation of the new holographic HUD, with the innovations and corrections which were made as aforesaid, **is** the invention forming the subject-matter of the Patent".

In his argument in the Appeal, learned counsel for the Respondents, Advocate Gabrielli, did not dispute the finding that the Patent is a combination patent, subject, of course, to his arguments regarding the Patent's invalidity. Mr. Gabrielli agreed during the hearing before us that:

> "The combination of the Patent is a combination of a holographic lens made with sources near the pupils, together with means of correction or compensation which neutralize the aberrations formed".

The Question of Infringement

13. Section 13 of the Patents Law 5727-1967 (hereinafter "the Law") provides -

> "The specification shall end with a claim or claims defining the invention..."

Pursuant to Section 49 of the Law:

> "A patentee is entitled to prevent any other person from exploiting, without his permission or unlawfully, the invention for which the patent has been granted, whether in the manner defined in the claims or in a manner similar thereto and involving the main features, as defined in the claims, of the invention which is the subject-matter of the patent (exploitation as aforesaid hereinafter referred to as "infringement")".

From this it follows, that the scope of the legal protection of the patent, or - as it is commonly termed, the "scope of the monopoly of the patent" - must be determined by the definition in the Claims. However, apart from the Claims, the Specification of the Patent also contains another part, the Description of the Patent. The function of the Description is to set forth the background of the Patent and describe its nature, its purposes and how it works. The function of the Claims is to define precisely and carefully the scope of the monopoly. The description sometimes includes drawings. The lower court defined the relationship between the components of the Specification, with respect to the interpretation of the Patent and the determination of its scope:

> "...The interpretation of a patent is no different from the interpretation of any other document... It should be interpreted as an 'integrated and complete document' and one may not disconnect one part from another artificially. Therefore, one should not separate the Claims from whatever precedes them, as if they had been created anew. However, when the court is required to interpret whether an

> infringement occurred, it will first refer to the Claims, and it will refer to the Description of the Patent only if it finds it difficult to explain the Claims or if it encounters unclarity.
>
> …
>
> Thus, the proper manner of interpretation is to read the Claims and interpret them standing by themselves, and if they are unclear, reference may be made to the Description in the Specification in order to clarify them or to understand what the inventor meant when he drafted the Claims as he did. In any case, the Description cannot enlarge or narrow the content of the Claims".

With regard to the interpretation of the terms appearing in the Specification, the lower court stated:

> "As stated earlier, the interpretation of a document is generally a legal question which the court must decide, but when the court interprets technical terms appearing in a patent Specification, it must interpret them as they are understood by members of the profession, as established by the testimony of experts in that field. One may also bring evidence that technical and scientific terms appearing in the Specification may be given different interpretations, depending on the context in which they appear.

> Sometimes, terms in the Patent should not be given their ordinary and usual technical meaning, if the patentee gave them a different meaning in the Specification, on the basis of which he worded the Patent".

As concerns the importance of the drawings in the Description, the lower court stated:

> "The first part of the Specification (the Description) sometimes also contains drawings. These drawings - which are naturally attached to the Description related to them - also play a part whenever the Description on its own is insufficiently clear".

14. Thus, the interpretation of a patent is no different in substance from the interpretation of any other document, and the normal principles of interpretation applying to documents will also be applicable to a patent. However, caution is called for in interpretation due to the special nature and power of a patent, in that it accords a form of market monopoly. It is a basic principle of interpretation that a patent must be read as a whole document, in order to discover the inventor's intent, as expressed in the document. As Judge Asher said in C.F. (TA) 2051/69 [11] at page 247, "It cannot be said that the claims should be separated from whatever precedes them, as if they had been created anew". Therefore, the Patent Claims should not be read in isolation from the Description and the drawings. Although the Patent is intended primarily for the professional in the relevant field, and it should therefore be interpreted in the light of the professional knowledge which existed at the relevant time, nevertheless, since the aim of the task of interpreting the Patent is to discover the inventor's intent, a certain degree

of flexibility is allowed in giving meaning to the terms and expressions appearing in the Claims, and the Patent Description may serve as a glossary for these terms and expressions. In other words, the inventor may be, to a certain degree, the lexicographer of his invention.

As Viscount Haldane said in a famous judgment of the House of Lords, to which I will return later, *British Thompson-Houston Co. Ltd. v. Corona Lamp Works Ltd.* (1922) [30], at 67 (hereinafter - "the Corona case"):

> "We have to scan the Specification with the closeness which is required in the case of any instrument conferring a monopoly, but, subject to this, all we can legitimately do is to apply the ordinary rules for the construction of written instruments. One of these... is that the instrument must be read as a whole. The Claiming Clauses, for example, are not to be taken as standing in complete isolation. For if the Patentee has used in these clauses expressions which he has already adequately interpreted in the body of his Specification, he is entitled to refer to the Specification as a dictionary in which the meaning of the words he uses has been defined."

See also the statements of Lord Diplock in *Catnic Components Ltd. v. Hill & Smith Ltd.* (1981) [31], at 65-66:

> "My Lords, a patent specification is a unilateral statement by the patentee, in words of his own choosing, addressed to those likely to

> have a practical interest in the subject matter of his invention (i.e. 'skilled in the art'), by which he informs them what he claims to be the essential features of the new product or process for which the letters patent grant him a monopoly... A patent specification should be given a purposive construction rather than a purely literal one derived from applying to it the kind of meticulous verbal analysis in which lawyers are too often tempted by their training to indulge."

See also: T. A. Blanco White, *Patents for Inventions,* (London, 5th ed., 1983) 9-15, 130-131; T. Terrell, *On the Law of Patents*, (London, l3th ed., by W. Aldous and others, 1982) 72; H. G. Fox, *The Canadian Law and Practice Relating to Letters Patent for Inventions,* (Toronto, 4th ed., 1969) 215- 218.

The separation between the Claims chapter and the Description chapters was not the common practice in former times, but it was a natural development arising from the inherent tension between the need to delimit the monopoly on the one hand, and the duty to disclose to the public detailed information on the manner of embodiment of the invention, on the other hand. This tension, and the nature of the Claims chapter of the Specification, was discussed by the House of Lords in *British United Shoe Machinery Co. Ltd. v. A. Fussel & Sons Ltd.* (1908) [32], at 650:

> "Correct delimitation was of the greatest possible importance to the inventor, because if his Patent covered something which was old the Patent was wholly bad. At the same time there was the danger of confining himself to a mere outline which gave delimitation but did

> not tell the public the best way within those limits of performing his invention. The one duty required him to state his invention in its most general form and the other duty required him to state it in its best and therefore in a very special form. Out of that has arisen the practice, which originally was perfectly optional, of having a separate part of the Specification primarily designed for delimitation."

In light of the foregoing, I do not believe that we should accept the interpretative approach of the lower court, to the effect that the Claims should be interpreted on their own, and that reference may be made to the Description only if they are found to be unclear on their face. Although this approach was typical of court rulings in the past (see, for example, the references cited by Fox, *supra,* at 217, and the same might be deduced from Judge Asher's statements in C.F. (TA) 2051/69 [11], at p. 250), it nevertheless leaves the recital of information and the facts incomplete, and the courts have not continued to adopt it, as is evident from the statement of Master of the Rolls Evershed:

> "It is... legitimate and appropriate in approaching the construction of the claims to read the specification as a whole. Thereby the necessary background is obtained and in some cases the meaning of the words used in the claims may be affected or defined by what is said in the body of the *specification." (Rosedale Associated Manufacturers Ltd. v. Carlton Tyre Saving Co. Ltd.* (1960) [33], at 69.

The logic underlying this interpretative approach was discussed by the American Court of Claims in *Autogiro Company of America v. United States* (1967) [13], at 396-97:

> "Claims cannot be clear and unambiguous on their face. A comparison must exist. The lucidity of a claim is determined in light of what ideas it is trying to convey. Only by knowing the idea, can one decide how much shadow encumbers the reality. The very nature of words would make a clear and unambiguous claim a rare occurrence...
>
> Allowing the patentee verbal license only augments the difficulty of understanding the claims. The sanction of new words or hybrids from old ones not only leaves one unsure what a rose is, but also unsure whether a rose is a rose. Thus we find that a claim cannot be interpreted without going beyond the claim itself. No matter how clear a claim appears to be, lurking in the background are documents that may completely disrupt initial views on its meaning."

This interpretative rule is also expressed in the Patent Convention of the European Economic Community, which expressly provides that the Claims should be interpreted in the light of the Description and the drawings (Community Patent Convention, 1975, Art. 69; W.R. Cornish, *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (London, 2nd ed., 1989)).

Incidentally, German law has adopted the liberal approach according to which the Claims are merely the *basis for* delimiting the invention, which is discovered by reading the Description and the drawings and by examining the total knowledge in the relevant technical field (E. Reimer, *Patentgesetz und Gebrauchmustergesetz,* 3 Auflage (1968)).

Thus, the proper interpretative approach is to interpret the terms and expressions appearing in the Claims in the light of the other parts of the Specification, with the aim of giving those terms and expressions the meaning which the inventor chose to give them. The meaning may be wide in scope or it may be narrow, provided that it is based on the Patent and is understandable to the professional (the man of the art) at the time of the Patent.

However, a distinction must be made between the manner in which the understanding of the monopoly can be widened and explained, and the delimitation of the invention. As stated earlier, reference may be made to the Description in order to better understand the monopoly; but it is not possible to rely only on the Description in order to claim a monopoly. What is not included in the Claims is not included in the scope of the monopoly:

> "The function of the claims is to define clearly and with precision the monopoly claimed, so that others may know the exact boundaries of the area within which they will be trespassers. Their primary object is to limit and not to extend the monopoly. What is not claimed is disclaimed. The claims must undoubtedly be read as part of the entire

> document and not as a separate document; but the forbidden field must be found in the language of the claims and not elsewhere... A patentee who describes an invention in the body of a specification obtains no monopoly unless it is claimed in the claims." *(Electric & Musical Industries Ltd. v. Lissen* (1939) [34], at 39, *per Lord Russell of Killowen).*

The above principle was summarized by the United States Supreme Court, per Justice Clark, as follows:

> "While the claims of a patent limit the invention, and specifications cannot be utilized to expand the patent monopoly... it is fundamental that claims are to be construed in the light of the specifications and both are to be read with a view to ascertaining the invention..." *(United States v. Adams* (1966) [14], at 48-49).

Fox summarized the matter as follows, *supra,* at 218:

> "The true rule is that, in construing the claims, reference may be made to the body of the specification for the purpose of interpreting the phraseology used, but, once the true meaning of the claims is arrived at, it is not legitimate to add to, subtract from, or in any way vary their scope by reason of matters that appear in the body of the specification."

15. As stated in Section 49 of the Law, the protection accorded to the patentee applies not only to literal infringement of the Patent, but also to the taking of **the substance** of the invention, i.e. its content and essence, or in the words of English law - the "pith and marrow" of the patented invention. The basis of this principle is in the aim underlying patent law - to protect **inventions,** not drafting.

Learned counsel for the Respondents contended that the Appellant is estopped from claiming that the substance of the invention was infringed. The Appellant relied in its pleadings at all times on literal infringement of **all** elements of the protected invention, and it should have pleaded separately, and proved with evidence, infringement of the substance of the invention. The lower court rejected the first argument on the basis of the facts, since it determined that one cannot conclude from the Appellant's arguments that it limited its claim to literal infringement only. However, the court accepted the second argument, ruling that the Appellant failed to submit sufficient evidence to prove infringement of the substance of the invention, an argument which was raised indirectly, during summation. There was a procedural arrangement between the parties that all evidence on technical matters would be submitted to the lower court in written opinions, and in this framework the question of the substance of the invention was not analyzed at all.

In my opinion, this approach is not acceptable, because it is not based on the wording of the law or on any concept underlying the protection of the invention from the taking of its substance. When patent infringement is claimed, the court must delimit the monopoly protected by the Claims, which entails interpretation of the Claims, according to the principles enumerated above. The task of interpretation is given to the

court, which considers all the evidence before it and defines the scope of the monopoly. Forbidden entry into this area constitutes infringement of the patent, and for this purpose, no distinction is made between literal infringement and taking its substance:

> "The substance of the invention must be proved from the content of the Patent Claims - as provided by Section 49 of the Law... What the Claims mean, and what is the substance of the invention defined in the Claims, is a question of law to be resolved by the court..." (C.F. (TA) 2051/69 [11], at p. 245).

Section 49 of the Patents Law follows this path and includes in the term "infringement" both of the above types of infringement (see also C.A. 314/77 [l], at p. 213). This is also the opinion prevailing today in English law, particularly since the statements of Lord Diplock in the *Catnic* case [31], *supra, at* 65*:*

> *"*... both parties to this appeal have tended to treat 'textual infringement' and infringement of the 'pith and marrow' of an invention as if they were separate causes of action, the existence of the former to be determined as a matter of construction only and of the latter upon some broader principle of colourable evasion. There is, in my view, no such dichotomy; there is but a single cause of action and to treat it otherwise, ... is liable to lead to confusion."

And see also Blanco White, *supra, at* 21*:*

> "The question of immaterial variations was in most older cases treated either by saying that a claim could be infringed by anything 'substantially' within it; or by treating questions of infringement as if there were two sorts of infringement, 'textual' infringement by things actually within the language of the claim and 'infringement by taking the pith and marrow of the invention' by things not quite within the claim. The more recent cases implied that whichever way the point was phrased, the question was primarily one of interpretation of the claim, although at some point it merged into a residual question of 'fact and degree'. ... It is now clear, however, that there is only one sort of infringement and that the whole matter depends on correct interpretation of the claim."

See also Cornish, *supra,* at 159.

This conclusion is consistent with the logic underlying the expansion of the protection of patent law beyond literal infringement. The words of the American Supreme Court in the leading case on the subject are apt:

> "In determining whether an accused device or composition infringes a valid patent, resort must be had in the first instance to the words of the claim. If accused matter falls clearly within the claim, infringement is made out and that is the end of it. But courts have also recognized that to permit imitation of a patented invention which does not copy every literal detail would be to convert the protection of the patent grant into

> a hollow and useless thing. Such a limitation would leave room for - indeed encourage - the unscrupulous copyist to make unimportant and insubstantial changes and substitutions in the patent which, though adding nothing, would be enough to take the copied matter outside the claim, and hence outside the reach of law. One who seeks to pirate an invention, like one who seeks to pirate a copyrighted book or play, may be expected to introduce minor variations to conceal and shelter the piracy. Outright and forthright duplication is a dull and very rare type of infringement. To prohibit no other would place the inventor at the mercy of verbalism and would be subordinating substance to form. It would deprive him of the benefit of his invention..." *(Graver Tank & Mfg. Co. v. Linde Air Product Co.,* (1950) [15], at 607, *per Jackson* J.).

In practice, literal infringement hardly exists, because it would frustrate the infringer's aims. Generally, the infringer would not follow the wording of the claims exactly, but would attempt to show that the product which it is claimed infringes differs from the protected invention *(Clark v.* Acke (1877) [35], at 320; Lipscomb's Walker, On *Patents* (New York-San Francisco, 3rd ed., by E. B. Lipscomb III, Vol. VI, 1987) 512; C.F. (TA) 2051/69, *supra,* at p. 248), and there is no logical reason to demand the setting forth of separate and additional facts for assessing the question of the substance of the invention.

16. The taking of the substance of an invention may be accomplished in a variety of ways, depending on the imagination and sophistication of the patentee's competitor.

Therefore, one should not fix rigid rules for identifying these ways. In English law, the doctrine of variations is applicable on this point, according to Which, variations in the components of a protected invention that do not affect the functioning of those components as claimed in the Patent will not protect from a charge of infringement:

> "... the claims must be read as covering the taking of the substance of what is claimed with 'immaterial variations'... there must, as compared with what is claimed, still be 'substantially the same parts acting upon each other in substantially the same way' *(Rodi & Wienenberger v. Showell,* (1969) R.P.C. 367 at 381)." (Blanco White, *supra,* at 19).

The determination whether the variations affect the functioning of the invention is made in light of the contents of the Patent and the professional knowledge in the relevant field as it existed on the date of filing of the application for the Patent. The question is, in every case, whether the experts who read the Patent would have understood that the inventor intended that utilization of any component of the invention exactly as described in the Patent would constitute a significant and critical requirement for protection, or whether changes to any such component, which do not significantly affect the functioning of the invention, would fall within the ambit of the Patent. As Lord Diplock said in the *Catnic* case [31], at 66:

> "The question in each case is: whether persons with practical knowledge and experience of the kind of work in which the invention was intended to be used, would understand that strict compliance with a particular descriptive word or phrase appearing in a claim was

> intended by the patentee to be an essential requirement of the invention so that any variant would fall outside the monopoly claimed, even though it could have no material effect upon the way the invention worked.
>
> The question, of course, does not arise where the variant would in fact have a material effect upon the way the invention worked. Nor does it arise unless at the date of publication of the specification it would be obvious to the informed reader that this was so. Where it is not obvious, in the light of then-existing knowledge, the reader is entitled to assume that the patentee thought at the time of the specification that he had good reason for limiting his monopoly so strictly and had intended to do so, even though subsequent work by him or others in the field of the invention might show the limitation to have been unnecessary. It is to be answered in the negative only when it would be apparent to any reader skilled in the art that a particular descriptive word or phrase used in a claim cannot have been intended by a patentee, who was also skilled in the art, to exclude minor variants which, to the knowledge of both him and the readers to whom the patent was addressed, could have no material effect upon the way in which the invention worked."

This statement was innovative when it was made, but today it is the prevailing rule in England and in the courts of common law countries (see for example the references of the Court of Appeals cited by Cornish, *supra,* at 162 n. 20).

The taking of the substance of the invention is also possible by **replacing** the components protected in the Patent with other, different components. To cope with the problem of infringements of this type, the **doctrine of equivalency** was developed. In the United States, this doctrine is the main yardstick for testing the substance of the invention, and it was described in *Graver Tank* [15], *supra,* at 608-609, as follows:

> "The essence of the doctrine is that one may not practice a fraud on a patent... 'To temper unsparing logic and prevent an infringer from stealing the benefit of the invention' a patentee may invoke this doctrine to proceed against the producer of a device 'if it performs substantially the same function in Substantially the same way to obtain the same result.' The theory on which it is founded is that 'if two devices do the same work in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form or shape'... What constitutes equivalency must be determined against the context of the patent, the prior art, and the particular circumstances of the case... It does not require complete identity for every purpose and in every respect... Consideration must be given to the purpose for which an ingredient is used in a patent, the qualities it has when combined with the other ingredients, and the function which it is intended to perform. An important factor is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was." (References omitted - M.S.)

Accordingly, the replacement of a component of the invention will not prevent a conclusion of infringement if the competing product functions in a substantially identical manner to the invention, which is accomplished by substantially identical means to those claimed in the Patent. It is not enough that the functioning of the competing product is identical to the functioning of the invention, and there is no infringement merely because both accomplish the same result. For the competing product to invade the protected territory, the ways and means of attaining the function or accomplishing the result must also be identical (see Lipscomb's Walker, *supra,* (vol. VI), at 549-554). The doctrine of equivalency also prevails in English law, where it is called the "doctrine of mechanical equivalency". Where a minor and non-essential component of the invention is involved, there will be an infringement, both when the component was replaced by an equivalent component and when the component was *omitted* completely from the infringing product:

> "It is... clear law that if a feature is not an essential of the claim, a device having such features as are essential will fall within the claim, whether the inessential integer is replaced by something else or omitted altogether..." (Blanco White, *supra,* at 20).

Another principle is that the greater the contribution of the invention to the professional field, the more the courts will tend to widen the territory protected by the Patent:

"Since the purpose of the doctrine of equivalents is to give the inventor an opportunity to secure a just reward for his invention - an opportunity which he would otherwise be denied because of the failure of the language of his claim to include devices which were in fact the same as his own in function, means, and result - the degree of protection afforded beyond the language of the claims will vary directly with the value of the inventor's contribution to the art. As the principle is commonly put, the inventor is entitled to a range of equivalents commensurate with the scope of his invention: broad if his invention is broad; narrow if his advance is a small one in a crowded field." *(Nelson v. Batson* (1963) [16], at 135; Lipscom's Walker, *supra,* vol. VI, at 546-547; 60 *Am. jur*. 2d (New-York and San Francisco, 1987) 630).

17. The doctrine of variations and the doctrine of equivalency are, as stated above, the yardsticks for testing whether the substance of the invention was taken, and I do not accept the Respondents' contention, which the lower court did accept, that it is doubtful whether the latter doctrine was adopted by Israeli law. I can only cite the words of Judge Asher in the aforesaid C.F. (TA) 2051/69 [11], at page 250):

"Anyone who takes the important parts of an invention and uses them to make his product - will be deemed to have infringed the Patent, even if he did not use unimportant parts of it, or changed those parts, or replaced them with **equivalent** parts... It appears to me that when the legislature spoke of the 'substance of the invention' in Section 49

of the Law, it meant the doctrine of the 'pith and marrow' as described above, no more and no less" (Emphasis added - M.S.).

Furthermore, this Court has ruled that "the doctrine of equivalency is a part of the question of inventive step" (C.A. 433/82 [2], at page, 539), and there is no reason why this doctrine should not also be considered within the framework of the question of infringement.

And now to the Patent before us.

18. The Respondents contended before the lower court that Respondent 2's product does not infringe the Patent, because two elements in Claim 1 of the Patent do not appear therein. These two elements are:

(a) Two coherent sources used to create the hologram, located relatively close to the entry pupil and the exit pupil.

(b) A means located along the axial beam, between the CRT and the combiner, to compensate for the axial astigmatism aberrations.

As for the first element, the Respondents argued that the hologram used by Respondent 2 is not made with the sources located relatively close to the aforementioned pupils. As for the second element, the Respondents argued that in the Respondent 2's product, there is no such means of correcting the aberration called "axial astigmatism".

Most of the rest of this judgment will be devoted to examining the question of the existence of the above two elements in Respondent 2's product. The District Court concluded that the second element exists in the product against which the claim of infringement was made, but the first element, which concerns "the relative closeness of the sources to the pupils", does not exist therein. The lower court therefore concluded that the Appellant's Patent was not infringed. The Appellant seeks to overturn the ruling on the question of relative closeness. The Respondents, in addition to supporting the lower court's conclusion on this point, seek a ruling against its conclusion that the Patent was not infringed also because the second element mentioned above, i.e. the means of correcting the aberration, is not present in the product. Naturally, it would be sufficient for us to find that one of the above elements is not present in the product to rule that the Patent was not infringed and to reject the Appeal on this point.

We will now examine the existence of the first element, i.e., the question of the relative closeness of the sources.

The Location of the Sources

19. Before commencing our examination of the meaning of relative closeness, which is the core of the dispute, we must first clarify the meanings of the other terms used in the definition of this element.

There was a dispute between the experts and the counsel for the parties as to the meaning of the terms "two coherent sources" and "exit pupil". The lower court

preferred, for both terms, the definitions of the experts for the Appellant, and since the present dispute does not extend to this point, those definitions are acceptable for our purposes.

(a) **Two Coherent Sources**

The lower court accepted the version of the Appellant's experts, Gray and Hesselink, that:

> "When an aberrated light source is used, the source of the laser is not a point, it is in fact a kind of stain or cloud of light which is delimited at both ends by the vertical point source and the horizontal point source. Therefore, the location of the laser source cloud is defined by reference to the point sources; i.e., the vertical point source and the horizontal point source. When designing it, one must make sure that one of the above point sources is near the pupil. In a system such as the HUD, the side of the cloud which is near the vertical point source must be placed near the pupil".

(b) **The Exit Pupil**

The District Court had the following to say about the meaning of this term:

> "The starting point in designing a HUD is the pilot's eye. The whole point of design is to ensure that the pilot sees most of the

> light beams as clearly and fully as possible. The treatment and location of the beams are aimed at correcting the optical aberrations as much as possible and enhancing the optical efficiency of the light beams which the pilot is to use. To handle these beams, we must first fix the position where the pilot's eye will be during flight. This allows the designer to treat only those beams which will be used by the pilot, i.e. those coming from the combiner to the position where the pilot's eye will be. This position is fixed by locating an imaginary reference plane at the center of the area where the pilot's eye will be during flight. This reference plane is in the form of an 'aperture' and its position is entered into a computer as the basis for making the various calculations concerning it".

The court accepted the definition of the Appellant's experts that the "exit pupil" of the HUD is the "aperture" described above, and as learned counsel for the Appellant, Advocate Goldenberg, said:

> "The term 'exit pupil' means the smallest aperture of relevant beams. This is an imaginary reference window which is placed at the center of the viewing area. It is therefore commonly called the 'pilot's eye' or the 'center of the viewing area'."

(c) There was no dispute between the parties regarding the location of the entrance pupil. Its location was determined with reference to the location of the exit pupil on the

basis of known optical equations, and it is the place where the exit pupil will be placed on the other side of the hologram, i.e. the side where the CRT is.

20. Now to the main question in this Appeal, i.e. what is the meaning of the expression "relatively close" appearing in Claim 1 of the Patent.

There are two aspects to this question. First, does the expression "relatively close" mean physical distance, or is it a functional expression? In the Appellant's opinion, it is a functional expression, i.e. "relatively close" means "as close as possible provided that optical efficiency is achieved in the hologram". This optical efficiency is achieved whenever the system's principal beams satisfy the Bragg condition. On the other hand, the Respondents argue for the physical intepretation of the expression, i.e., that "relatively close" refers to the physical distance between the sources and the pupils.

The second aspect - if we accept the physical interpretation of the expression "relatively close" - is whether in order to measure the physical distance between the sources and the pupils it is necessary to consider a certain angular deviation between the location of the sources and the pupils, since this deviation is present in Respondent l's product. In the Appellant's opinion, this deviation should be ignored when calculating the physical distance. The Respondents contend, on the other hand, that the physical distance should include the angular deviation.

Finally, of course, it will be necessary to resolve the question of the existence of relative closeness in Respondent 2's product.

"Relatively Close" - Physical or Functional Interpretation

21. The lower court accepted the physical intepretation of the expression "relatively close", saying -

> "In this dispute between the Plaintiffs experts and the Defendants' expert, I hold for the Defendants. I find that it is not possible to conclude from the Patent, neither from the wording of the Claim nor from the description in the Specification, that the **functional** factor is decisive on the question of what is 'relatively close'. I have read and re-read the wording of Claim 1, in order to determine whether it is possible to interpret it as argued by counsel for the Plaintiff, but I find it difficult to interpret the Claim this way. The only source in the Specification that speaks of functional efficiency, which Dr. Goldenberg cited as evidence of the inventor's intent, is on page 3...
>
> However, this section is in the chapter which describes the prior art, and I cannot see how it can be interpreted as describing the patented invention. It merely describes the prior art in the profession about the results achieved when the sources are placed near or on the pupils, and it has nothing whatsoever to do with the inventor's interpretation of "relatively close". If in the entire Specification, which covers 30 pages, one finds only this brief passage, comprising just a few lines, which deals with such a significant subject as the functional efficiency (which, as stated, appears in the chapter dealing with the prior art), it is only

because the functional factor is unrelated to the interpretation of the expression 'relatively close' in Claim 1 of the Patent."

The Appellant's contention on this point may be summarized as follows:

The use of a functional definition is acceptable and sometimes essential in patent law. The fact that the present Patent adopted a functional definition is evident from the following:

(a) The functional definition is evident from a reading of the Patent (pp. 1-3, 13 and 14). The lower court erred in ruling that it one should not rely on page 3 of the Specification, which speaks of functional efficiency, on the ground that this passage belongs to the "Prior Art" chapter and that it was brief relative to the length of the Specification. First, the description appearing in the aforesaid chapter also appears on page 14 of the Patent, in the chapter describing the invention. Second, since it is a combination patent, there is nothing to prevent some of its components from appearing in the "Prior Art" chapter. Third, the brevity of the description is the result merely of the fact that it is a well known component, about which details need not be given. During the hearing before us, in the course of replying to the Respondent's pleading, learned counsel for the Appellant enlarged upon this argument by saying that in a functional patent there is no need to include the protected result in the Claims chapter of the Specification.

(b) The term "relatively close" is a technical term which should be interpreted according to the testimony of the experts. The experts for both parties agreed that it is a

"term of art", which is perceived as such by the community of scientists dealing with holographic display systems. Respondent l's experts admitted that this term expresses a functional definition, in the present Patent as well, but they changed their minds at a later stage.

(c) The degree of relative closeness between the sources and the pupils may vary among display systems which are identical to the invention. Even the Respondents' experts admitted this. Accordingly, the functional intepretation should be preferred.

(d) There is no alternative to the functional definition. Neither the Respondents nor the lower court suggested any **specific** physical distance as the definition of relatively close; Respondent 1 only explained that it is "a very small distance". The only distance mentioned by the court was five inches.

The Respondents argued that the functional interpretation is unacceptable, for the following reasons:

(a) It is not possible to conclude from the Patent that the term "relatively close" reflects a functional definition. The mention of optical efficiency in the Specification cannot establish such a definition. All that is evident from the Patent is that the term refers to a very small distance, of a few millimeters, in which the two points are located, almost one on top of the other. This is actually the interpretation which the District Court accepted. There is no mention whatsoever in Claim 1 of optical efficiency, Bragg condition, width of field of view, or anything else which connects the expression "relatively close" to the proposed functional interpretation. Since a holographic lens

which is made with sources located near the pupils is part of the prior art, the inventor did not dwell on this subject in the Patent Claims. The substance of Claim 1 is the means of correcting the aberrations, and the other Claims (2 to 10) also deal with these means. Only the last Claim (11) deals with one of the examples of the device, the one concerning the helmet.

(b) The Appellant's experts also held, in their first opinion, that the physical interpretation of the term is the correct one. They measured the distances between the sources and the pupils in Respondent 2's product, and when they found that they were very small distances, they determined that they are relatively close. Only at a later stage, in their second opinion, which was given in reply to the opinion of the expert for the Respondents, did the Appellant's experts raise the functional interpretation, as contended.

(c) Adoption of the functional interpretation would lead to absurd results which are inconsistent with the wording of the Patent. According to this interpretation, if the optical efficiency is high for the chief beams, then the sources are relatively close to the pupils, but if the optical efficiency is low they are not relatively close, even if physically the sources are close to, or even on top of, the pupils. The latter may occur, according to the Respondents, if low optical efficiency is achieved due to various factors in the manufacture of the hologram, such as the degree of exposure to laser beams or the method of development, which affect the optical efficiency but are unrelated to the closeness of the sources to the pupils.

22. The Respondents' last contention is unacceptable to me, on its face, so I will deal with it immediately. The technique (which was known) of placing the sources near the pupils, by which the optical efficiency of the system is achieved, must assume that the other components and processes which are used to build the hologram and which may affect its efficiency were exhausted optimally to achieve the highest possible optical efficiency. When according to the functional interpretation we examine whether optical efficiency is achieved by the factor of relative closeness, it is only natural that we assume that the other factors will remain unchanged *(ceteris paribus)*. The fact that the optical efficiency achieved by this factor can be adversely affected by manipulating the other parameters (degree of exposure and development method, etc.) should not change the theoretical outcome - that if the other parameters had been properly and optimally implemented, it would have been potentially possible to achieve optical efficiency. In other words, according to the functional interpretation, the optical efficiency should be assessed only as the outcome of the distance between the sources and the pupils, and not as a function which is accompanied by other variables that are unrelated to this distance.

Furthermore, so far as the court knows, optimum exposure or development of the hologram do not create new problems in the device, as is the case with the closeness of the sources to the pupils, as a result of which the aberrations are caused. It is therefore unclear why the manufacturer of the hologram should want to exposure or develop it in a way which would reduce the optical efficiency, because this efficiency is one of the main goals of the device. A product which is not optically efficient will in any case be a failure, and it is doubtful whether there will be any need at all for a Claim concerning its infringement.

The situation will be different in a case where high optical efficiency is achieved by means which do not involve closeness of the sources to the pupils. For example, if it would be possible to achieve high optical efficiency while leaving the sources at the image plane and infinity, then the outcome would be that this efficiency would not be achieved due to the element of "relative closeness" inherent in the invention.

23. The use of a functional definition and relative terms is known in patent law, and it appears in the topic called "claim limited by result". Blanco White, *supra,* at 145-146, writes about patents of this type as follows:

> "It is permissible to limit the claims of a patent to that which gives a particular useful result if, and only if, those engaged in the art concerned can determine whether or not they have attained that result either by employing a proper criterion set out in the specification or by conducting simple experiments.
>
> It follows from the rule that claims must be as clear as the subject admits of, that particular care must be taken when claims of this sort are adopted to give in the specification all possible assistance in determining what does, and what does not, give the useful result concerned: clarity of claim and sufficiency of description go together here. Thus a claim limited by result has been held bad for ambiguity where the instructions for attaining the result were meaningless to those in the art. In addition, it must not be forgotten that there is no

> authority for putting upon the reader of the specification the burden of making any but 'simple' experiments. Just what the word 'simple' means in this context is not clear; all that is certain is that invention must not be required in order to determine whether a claim is infringed or not."

In other words, a Patent Claim can and will be defined according to whether it achieves a specific result. However, fear of overbreadth and vagueness of the Patent in such a case require clear definition of the result protected in the Claims and disclosure of sufficient information in the Patent Specification to allow anyone skilled in the art to know whether he is within the scope of the Patent without recourse to anything more than simple experiments which entail no inventive step.

In discussing the requirement of sufficiency of the description, Blanco White stresses the importance of accuracy and clarity in a patent limited by result, *supra,* at 137:

> "Sufficiency of description deserves special consideration in connection with claims limited to the securing of a particular result, in view of the need for any claim to be as clear as the case allows. Such claims, in effect, put upon the reader of the specification the burden of seeking to carry out the invention in order to determine where the boundaries of the monopoly lie, so that the specification must not only enable the reader to carry out the invention claimed in the form of a single preferred embodiment, but also enable him to ascertain whether

> the particular result concerned is or is not secured by forms of the invention lying near the boundaries of the claim. Further, it would seem that in such a case the specification cannot be fair unless it discloses any information the applicant may have as to the sort of departures from the preferred embodiment that will lead to the desired result not being secured and as to unsuccessful experiments generally: the objection to 'forcing persons to make experiments in which they must afterwards be defeated' can hardly go less far, where the applicant obliges his readers to experiment over the whole field of the invention and does not merely invite them to try a preferred embodiment."

Blanco White continues by indicating the need to give details concerning which components or characteristics can help to achieve the protected result, *supra,* at 146:

> "... the distinction may well be, that it is legitimate to claim the attainment of a particular result by the adjustment or selection of particular characteristics or features, but not to claim the attainment of a result by any means whatever."

In the United States, see 60 Am. Jur. 2nd, *supra,* at 402.

It is important to distinguish here between a new result that was unknown prior to the invention and a result which is part of the art prior to the invention. In the former case, the inventor may be able to protect the achievement of the result in any manner.

In the latter case, such a claim would be considered too wide. If the result itself is not a novelty but was known, in the sense that it was a desired objective, the attainment of which was aspired to, one cannot claim a right for any possible manner of attaining it, but only for the specific novel way in which it was attained now. As Blanco White says, *supra,* at 146:

> "It is clear that the discoverer of a new principle is entitled to claim all devices making use of it: all modes of carrying it into effect. For in such a case the new principle itself will be a part of his invention. If however the principle itself is old, such a claim will be too wide, for then the inventor has contributed nothing new except any special method of carrying it out, and his claims must consequently be confined to such special methods.
>
> This distinction applies in particular where the 'principle' concerned is the advantageous character of a particular result. If the result is in itself new and not obvious, the inventor may - in theory, at least - claim all methods (including methods in themselves obvious) of attaining it. But if the result is known, either in the sense that it has been attained before or in the sense that it was an obviously desirable result if it could be attained, then a claim to any method of attaining it will be too wide."

24. The main efforts of the courts in dealing with the issue of patents limited by result were made, as we will see, in the form of requirements of sufficiency and clarity

resting upon the patentee. However, the present dispute becomes more severe in view of two very different questions, namely: First, in a patent of this type, does the protected result have to appear in the Claims themselves, as the Respondents contend, or is it sufficient that a result is specified in the Description, as the Appellant holds. Second, in a combination patent, may one of the known components of the invention - in this case a component which causes the result - appear only in the Description, as the Appellant holds, or must the result be included in the Claims even in such a type of patent, as the Respondents claim.

On both questions, I hold for the Respondents, and I will now address them one by one.

25. Regarding the requirement that the result appear in the Claims, this seems to me obvious from what we have seen above and from the very definition of the subject as a "claim limited by result". However, since ample references have been submitted which prima facie support the absence of any such requirement, I will expand this point.

A leading case on the subject of claims limited by result is the judgment of the House of Lords in the afore-mentioned *Corona* case [30], which involved an invention entailing improvements to electric light bulbs, which gave the light bulbs advantages of power and useful lives which previously were impossible. The invention comprised several components, whose combination yielded the said advantages. Claim 1 of the patent was for:

"An incandescent electric lamp having a filament of tungsten or other refractory metal of **large diameter** or cross section or of concentrated (i.e. coiled) form and a gas or vapour of low heat conductivity at relatively high pressure, *the combination being such that the filament may be raised to a much higher temperature than is practicable in a vacuum lamp without prohibitive vaporisation or deterioration or excessive shortening of useful life,* substantially as set forth." (Emphasis added - M.S.).

It was argued against the Patent that the component "filament of large diameter" is insufficiently clear and does not define the scope of the monopoly, since a competing manufacturer would be forced to experiment with components of different diameters before he could know if he has infringed the Patent - because attaining the advantages attained by the inventor is the only test of infringement. The House of Lords upheld the Claim, ruling that the term "large" is sufficiently defined in the Specification because it is understandable to someone skilled in the art, and that attainment of the advantages of the invention is the test which should be applied by any competing manufacturer.

Learned counsel for the Appellant argued before us that just as there was no need to define "large" in the Claim, the patentee should also not be required to define the functional interpretation of "relatively close" in the Claims in the present case. I believe that this comparison is wrong. In a patent limited by result, a distinction must be made between the protected result on the one hand and the adjectives used to describe the relationship between the other components of the invention and the result, on the other hand. The dispute in the *Corona* case [30] did not center on the

question of including the result in the Claim, but only on the question whether the inventor could use an unquantified adjective ("large"). In fact, the House of Lords ruled that the degree of "largeness" need not be quantified in the Claim, in view of the Description (which describes in detail the usual sizes), but the result which is achieved by means of this "large" component is included in the Claim itself. The combination of the three components listed at the beginning of the Claim in the *Corona* case [30], one of which is a filament of large diameter, achieves the result specified at the end of the Claim: the filament may be heated to a higher temperature than possible in ordinary light bulbs, thus increasing the quantity of light emitted by the bulb, without any loss of energy which would have been caused previously as a result of evaporation and erosion and without shortening the light bulb's lifetime. As Viscount Finlay said at 77:

> "The workman is working to get the result *which is described in the later lines of Claim l,* and in choosing the degree of largeness he will be guided by the results yielded by particular sizes." (Emphasis added - M.S.)

The same is true in the case before us. The inventor will not be required to specify in the Claim the actual physical dimensions of the expression "relatively close", if this may be deduced from the Description and the general information in the relevant field. However, if the inventor wants to link the adjective to a specific result, i.e. optical efficiency, he must claim the result in the body of the Claim.

Another example of the above distinction is the American *Autogiro* case [13], which I mentioned above. The patent made improvements to aircraft propellors, and one of the Claims stated:

> "In an aircraft, a sustaining rotor construction having blades mounted for movement with respect to an axis member and *so proportioned* that, under the influence of air currents, the blades have an average autorotational speed of the tip substantially in excess of the maximum flight speed of which the craft is capable."

As is evident from the wording of the Claim, the result is actually included in it (at the end), but the adjective "so proportioned" is not quantified. In fact, it was contended that the invention could not be performed in this manner. Here too, the court ruled that it is permissible and possible to deduce the quantification of this proportion from the Description.

Learned counsel for the Appellant sought to base his thesis on another English case, of the Court of Appeals - *British Thomson-Houston Co. Ltd., Marconi's Wireless Telegraph Co. Ltd. and Electric and Musical Industries Ltd. v. Guildford Radio Stores and E.K. Cole Ltd.* (1938) [36]. This case involved an invention comprising improvements to thermionic valves of amplification systems ("radio tubes"), which for the first time made it possible to use voice amplification systems supplied by alternating electric current, such as that supplied by conventional household sources. The use of alternating current in voice amplification systems was not previously possible, because the alternating current would cause background noise (hum), which reacted to the

frequency of the alternating current. It was therefore only possible to use direct current (such as that supplied by batteries). The invention solved the problem of hum, by using a certain coil in the system which smoothed out the current. Claim 1 of the Patent was:

> "For a sound-reproducing device having operating and field windings, an amplifying system including a thermionic valve, the plate circuit of which is supplied from a source of alternating current and a rectifier, in which the field winding of the sound-reproducing device *is employed to smooth out fluctuation in the rectified current."* (Emphasis added - M.S.).

It was pleaded against the Patent that the desired result - noise prevention - did not appear in the Claim itself, from the wording of which it could be deduced that the Patent covers any case in which a coil in the system smooths out the current, including cases in which the desired result is not achieved; as such, the Patent is excessively broad. On the other hand, the Patentee argued that in view of the description and the prior art, limitation of the Patent to cases where the desired result is achieved is evident from the Claim. Judge Luxmoore accepted this proposition, as follows:

> In my judgment, claim 1 ought fairly to be construed as claiming a monopoly to use the field winding of the sound-reproducing device as the inductance member to smooth out fluctuations in the rectified current so as to eliminate the noise which, without its use in such manner, would result in the reproduction of the disagreeable hum from the alternating current used, and not as a claim to use the field

> winding for any degree of smoothing, no matter how small. In other words, in my judgment, on the true construction of this claim, the field winding must be substantially the device used for the particular purpose disclosed. On this construction I hold that claim 1 is neither too wide nor too vague and is not invalidated on either of these grounds."

Learned counsel for the Appellant sought to draw an analogy from this to the present case, i.e. that the result does not have to appear in the Claim. I believe that the two cases involve opposite problems. In the above Patent, the wording of the Claim, standing alone, was too wide, because it prima facie included cases in which the invention is ineffective. The court was prepared to refer to the Specification in order to reduce the range of results possible according to the wording of the Claim to the one in which the Patent achieves its advantages. Actually, limiting the Claim was logical in this case, because it is obvious to anyone that the inventor did not want to claim protection for that which is useless, as the court said, *ibid*. at p. 88:

> "... it is necessary to introduce into every claim limitations dictated by common sense after a perusal of the whole of the specification including the claims; and, secondly, that a claim is not to be invalidated for vagueness or ambiguity by reason of the fact that it is possible to imagine debatable territory where the advantages of the invention may not be obtained."

However, it cannot be argued that the result of noise prevention was not included in the Claim. The result achieved by the Claim was to smooth out the current, which in turn resulted in prevention of the noise.

In the present case, the wording of the Claim suffers from the opposite problem, i.e. it is *too narrow* to include the full range of cases in which optical efficiency is achieved in the system by satisfying the Bragg condition - because it is possible, theoretically, that optical efficiency will be achieved even if the sources are not *close* to the pupils. Therefore, even if the inventor sought to protect every case in which the sources are located relative to the pupils in a manner which achieves optical efficiency, he should have included this result in the Claim itself. As stated earlier, *enlarging* the Claim by reference to the Description is not permitted, particulary since the Description in the present case speaks of achieving optical efficiency by positioning the sources "at or close to" the pupils.

Another central ruling on this question was in the Court of Appeals in England in the case of *No-Fume Ltd. v. Frank Pitchford & Co. Ltd.* (1935) [37].

The Patent in this case was given for a cigarette ashtray which had a novel feature in that it trapped the smoke from cigarette butts thrown into it and prevented it from escaping (a "smokeless ashtray"). Regarding the various components of the invention, the Patent Claim stated that their dimensions, relative to one another and relative to the sides of the ashtray, should be such that the smoke from butts thrown into the ashtray's container would be gathered in full in an enclosed space, and once it cooled it would descend to the bottom of the container without any possibility of escaping. As for the

space itself, the Claim stated that its dimensions should be chosen in a way which assures the aforesaid cooling of the smoke. In the words of the Claim:

> "An ash receptacle which, without the use of moveable parts, retains the smoke rising from objects thrown into it,... [characterised by the fact that] it consists of a closed container into which extends a shaft of substantially constant cross section, the sides of which, with the sides of the receptacle, form a trapped space closed above, whilst wholly beneath the shaft is provided a deflecting member... which deflects objects thrown in wholly to one side of the lower mouth of the shaft... The dimensions of the shaft and of the deflecting member... being so chosen *relatively to one another and to the sides of the closed container, that the smoke rising from objects thrown into the container is collected entirely in the trapped space, and after cooling is thrown down again without being able during this movement to pass the lower mouth of the shaft."* (Emphasis added - M.S.).

Here, too, the result appears in the Claim itself.

The Court rejected the contentions that the description of the Patent was insufficient and unclear. The Master of the Rolls, Lord Hanworth, said, at 238:

> "It is not an objection that the dimensions should be selected by reference to the result, as one sees when one turns to the cases. It seems to me that the proportions can be ascertained without the

> exercise of any new inventive faculty, if the directions laid down are followed; because the purpose of the invention is to construct a space for cooling smoke, and yet that is to be done within the limits of what might be called the conventional ash receptacle. It appears to me that the proportions need not be exactly laid down by the description, according to the inches of a foot-rule, if there is a field in which the proportions may vary, and yet in which success may be achieved and ensured."

Lord Romer added, at 245:

> "... the Patentee does not tell the world within what limits the relative proportions of the integers he has mentioned must be kept to produce the desired result. If, however, a workman skilled in the art can by trial and error readily discover for himself what the proportions should be in order to give the desired result, then, in as much as I have already pointed out, that to discover those proportions requires the exercise of no inventive faculty at all, the Patentee has complied with his obligation."

The Judge also noted that the Patentee attached to the Description a drawing which described the structure of the ashtray as an example, so that anyone skilled in the art would he able to use the drawing as well as the general knowledge in the field.

Another relevant case is *Poseidon Industry A.B. v. Cerosa Ltd.* (1982) [38], which dealt with a "dry" diving suit. The advantages of this suit were that it was made of an elastic material which was tightly fitted to the diver's body, thus allowing him flexibility of movement in the water, while it also allowed a layer of air to envelope the diver's body so as to prevent painful friction with the suit and to create thermal insulation between him and the water around him. The following passage appeared in Claim 1 of the Patent, as well as in the Description:

> "... said suit being manufactured as a *close fit so that only a minimum breathable medium layer can form between the interior of the suit and the diver's body,* said material having such resilient properties that it may *fit tight* about the diver's body *such that said layer is maintained within the desired close limits."* (Emphasis added - M.S.).

In other words, to achieve the above beneficial results, which were set forth in the body of the Claims, the inventor used the terms "close fit" and "the desired close limits", which were unquantified.

Here too, in approving the Patent, the court ruled, by Lord Buckley, at 222:

> "... I feel no doubt that a competent expert in the field of deep-sea diving... could, with a little ordinary trial and error, discover what amount of latitude can be allowed in the amount of air imprisoned within the suit in order to achieve the desired advantages and what

amount of air can reasonably be regarded as a satisfactory minimum for that purpose."

26. Thus we see that in all the cases cited above, the desired result appears in the Claim itself, and is also explained in the Specification. In all the cases, the protected result accounts for the principal novelty and originality of the invention protected by the Patent. Although in the *British Thompson-Houston* case [36], the result was not mentioned explicitly in the Claims, it was nevertheless inferred from the result which **was** mentioned in them. It is noted that in all the cases the inventor did not merely mention the result, but devoted to it explanations and examples. The questions which arose in those cases were not whether they were patents limited by result - which was not in dispute - but only the sufficiency of the Description and of the information given by the inventor the public.

This is not the case in the present Patent. In Claim 1, as in the other Claims, there is no sign or hint of the result on which the Appellant seeks to rely. The Claim does not show the invention as achieving optical efficiency or satisfying the Bragg condition by locating the sources near the pupils. The Claim only mentions the technique of locating the sources near the pupils, and adds the principal novelty of the invention, i.e. the combination of the said known technique with correction of the optical aberrations created by it.

27. Appellant's other contention was that since the Patent is a combination patent, the inventor does not have to specify the known components of his invention in the

Claims, and that it is possible to deduce these from the Description. I do not accept this contention either.

A combination patent is unique in that the protection is granted for the combination of two or more components, where the **combination itself** results in a patentable invention. Since the invention is assessed as a combination, there is nothing to prevent its various components from being known on their own or from lacking any inventive step of their own. As Lord Davey said in the leading case *In the Matter of klaber's Patent* (1906) [39], at 469:

> "A proper combination for a Patent is the union of two or more integers, every one of which elements may be perfectly old, for the production of one object which is either new, or at any rate is for effecting an old object in a more convenient, cheaper, or more useful way."

In fact, the scholars have commented that most of the modern patents are of this type (Fox, *supra,* at 50; Blanco White, *supra,* at 165).

The case law in this area concerns principally the distinction, which is not always easy to make, between a combination which is deserving of patent protection and a collocation of factors which do not interact with one another to achieve an integrated purpose, which is novel and involves an inventive step (see primarily: *Williams v. Nye* (1890) [40]; the aforementioned judgment in *British United Shoe Machinery* [32];

British Celanese, Ltd. v. Courtaulds Ltd. (1935) [41]; and in the United States, see *Anderson's Black Rock v. Pavement Salvage* (1969) [17].

However, even if the components of the invention were known, it is they which delimit the scope of the monopoly, so they must all appear in the Claims, and it is irrelevant for this purpose which of the elements were known and which are novel (see Terrell, *supra,* at 98). Allowing the Appellant's contention would lead to absurd results, for example, if all the components of a combination patent were known, none of them would appear in the Claims. Indeed, in the present Patent, not one of the components was novel on its own. Could it possibly be right to say that the inventor retains the right to choose which known components to include in the Claims and which to leave to the Description chapters? Such a conclusion is opposed to the foundations of patent law and to the distinction made earlier between the Claims and the Description.

28. To summarize, in a patent limited by result, the latter is one of the components of the invention, so the inventor must claim protection for it in the Claims. It is irrelevant for this purpose whether the desired result is the principal novelty of the invention or a known component of the various components of a combination invention.

The inevitable conclusion is therefore that in the present Patent, it is not possible to read into the Claims a result which was not mentioned in them and which cannot be read into them by a process of interpretation. The relative closeness of the sources and the pupils must be measured by physical criteria. The inventor need not specify the quantity of the physical distance in the Claims, and it may be deduced from the description, in the light of the professional knowledge in the field.

In light of this conclusion, I see no need to refer to the parties' pleadings concerning the volte face in the opinions and testimony of the various experts.

29. What then is the physical distance which is protected by the scope of the present invention, how is it measured and did Respondent 2 invade it?

The term "relatively close" in Claim 1 can be interpreted here in three ways:

First - An interpretation based on the prior art in the field, according to which the sources were located at infinity and near the image pupil. In other words, the deviation from the conventional configuration, as we called the prior art, led the Appellant to locate the sources near the pupils, relative to the prior art. I do not think this interpretation is reasonable, because it would cover any **distance** which is smaller than infinity, whereas the description shows that in the technique adopted by the Appellant, the sources are located "at or close to" the pupils, an expression which is certainly inconsistent with a distance close to infinity. It should be noted once again that this technique, insofar as the present Patent is concerned, also belongs to the prior art.

Second - An interpretation of the term with reference to the other parameters of the system, i.e. the distance between the sources and the pupils is small relative to the size of the relevant system and its various components. For example, in a system one meter in size, a distance of one centimeter is relatively small, but in a system five centimeters in size, this distance may not be small. This interpretation is consistent with the Appellant's contention that since the degree of closeness of the sources to the pupils

may vary from one system to another, the definition must be functional. Actually, the definition is functional in the sense that the physical distance may vary depending on the size and components of the system, but it is not functional in the sense of reading the result of optical efficiency into the Claim.

Third - Reading the term in the light of the Description, according to which, by the technique adopted by the Appellant, the sources were located "at or close to" the pupils. Since the distances involved are very small, and may even be zero, the Appellant sought also to protect small deviations from these distances which do not entail a deviation from the technique mentioned. The Appellant therefore adopted the wording "relatively close."

I believe that the term "relatively close" should be interpreted in the second and third ways in combination, i.e. the physical distance is very small, in the light of the Description, relative to the other components of the system; but a slight deviation from this closeness will not escape a charge of infringement.

As is evident from the deliberations before us, the size of the entire HUD is approximately one meter. Other relevant sizes which were mentioned are: focal length - 200 mm, and the distance between the pilot's eye and the HUD - 250 mm.

Learned Counsel for the Respondents agreed that a distance of 10 mm between the sources and pupils is "relatively close," and that even a slight deviation from this distance will be within the scope of the term. Measurements made by experts for the Appellant showed that in Respondent 2's product, one point source (the "reference point

source") is at a distance of 7 mm from the exit pupil, while the other point source (the "image point source") is at a distance of zero from the entrance pupil, i.e. exactly at the pupil.

This calculation shows, prima facie, that the factor of relative closeness is also present in Respondent 2's product. However, the Appellant's experts ignored in their calculations the angular deviation in the Respondent's product between the location of the vertical point sources and the pupils, at right angles to the direction of the hologram. If this deviation is taken into account, as the Defendants seek, the above distances will increase from 7 mm to 77 mm, and from zero to 110 mm. These distances are in excess of what the Respondents are prepared to consider "relatively close."

I will now examine this question.

Calculation of Physical Distance - The Question of the Angular Deviation

30. As stated earlier, the main advantage of the holographic combiner lies in the unique optical features of the hologram, which give it the characteristics of a selective mirror. The combiner must be built in such a way that light coming from the CRT can be reflected to the pilot's eye at an optimum angle, in order to satisfy the Bragg condition. The reflection angle is measured between the image point source and the line perpendicular to the hologram. Since the aim is that the light follow the said angle when the hologram is being used, it must be designed in the manufacturing stage of the hologram, by building an imaginary route which the information picture will follow.

Therefore, when the hologram is being built, a recording is made of the route, which is then played back when the hologram is in use.

The fact is that the optimum reflection angle is not identical when the **wavelength** of the light varies. Each wavelength has its own optimum relection angle. This phenomenon must be taken into account when designing the hologram, because it is recorded by means of laser beams at a specific wavelength, whereas during playback, light is reflected at a different wavelength (the light from the CRT). Therefore, to ensure that the light beams move at the optimum angle in the playback stage, it is necessary to shift the sources of the laser beams during the recording, thus compensating for the changing wavelengths. The shifting of the sources of the laser beams is made at an angle perpendicular to the hologram. In other words, the course of the light beams during the playback stage may be described as following imaginary laser beams of which the source is located at a position which is slightly shifted (at an angle perpendicular to the hologram) from the position where the laser sources are actually located. The wavelength variance is called "wavelength shift," and the deviation of the optimum reflection angle is called "the angular displacement."

In Respondent 2's product, the process of compensation described above required the displacement of the laser sources to distances of 77 mm and 110 mm from the locations of the pupils. If the compensation had not been necessary, i.e. if the laser beams had been of identical wavelengths during the recording and playback stages, the distances would have been reduced to 7 mm and 0 mm respectively. There is no dispute between the parties that the latter distances satisfy the condition of relative physical closeness, but there is no such agreement concerning the former distances. Therefore,

the question arose whether to take the angular displacement into consideration when calculating the distances.

31. In the lower court the Appellant pleaded that the angular displacement should not be taken into account when measuring the relative closeness. The phenomenon of wavelength shift, as well as the technique for compensating for it, were known and accepted in the professional field. The Patent itself stated that the location of the sources relative to the pupils was mentioned only to simplify the explanation for a case in which there is no variance between the recording and playback wavelengths. Alternatively, Respondent 2's product entails taking the substance of the Appellant's invention, which is locating the sources as claimed in the Patent in order to achieve a wide field of view. A parallel contention was that Respondent 2 utilized a mechanical equivalent of the patented invention.

The Court rejected the Appellant's contentions and accepted the Respondents' position that the angular displacement should be taken into consideration, quoting with assent the words of their learned Counsel:

> "All that the citations quoted by him [Counsel for the Appellant - M.S.] prove is that the inventor actually knew that the wavelength could be varied: nowhere does it say that the inventor knew of the technique of displacing the angle. There is no reference to any such technique in the Description, nor did the inventor hint at it. As Claim 1 is worded, only a combiner which is built with sources located 'relatively close' to the pupils falls within the Claim. The rules for

> measuring distance are based on common sense and reason, and anyone who proposes a method for measuring distance which deviates from these rules must prove his method. The Plaintiff did not satisfy this burden of proof since it did not cite any reference to any instruction by the inventor, or even knowledge of the inventor, that it is possible to deviate from the known and accepted rules for measuring distance".

After ruling that the angular displacement should be taken into account, the Court proceeded to resolve the question whether, in view of this consideration, Respondent 2's product should be deemed an infringement of the Patent. The Court answered this in the negative, because it rejected the hypothesis of the Appellant's expert that the sources may be shifted a distance of up to five inches from the pupils, i.e. 12 cm, while still remaining within the scope protected by the Patent. The judgment contains an error in this matter, when it said:

> "Prof. Hesselink (the Appellant's expert - M.S.) defined 'relative closeness' within the limits of five inches from the pupil. Accordingly, the sources are not 'relatively close' to the pupils in the Defendant's product."

After the Appellant filed a motion to amend the error, on the ground that the Court erred in its calculation, the Court ruled that the words "I do not accept his definition", which belong between the two sentences cited above, were omitted from the judgment erroneously. The Appellant criticised this decision in its appeal, but I find no reason to

intervene on this point. As the lower court stated in it's decision explaining the amendment:

> "This is also evident from the beginning of paragraph 61 [of the judgment - M.S.], where it is stated that my conclusion is 'in the light of the aforesaid', and it in fact follows from what I stated there."

The rejection of the Appellant's expert's hypothesis is supported and explained later in the judgment, and it is an inevitable consequence of rejection of the functional interpretation of the expression "relatively close."

32. I accept the lower court's ruling that in terms of the wording of the Patent, the angular displacement should be taken into account, and that according to the test we formulated for the question of "relative closeness," Respondent 2's product does not appear to infringe the Patent. However, as explained earlier, patent protection is not limited to a literal copy of its components in full, but it also covers the taking of the substance of the protected invention. The lower court did not consider the issue of the substance of the invention, but as is evident from the analysis of this issue, there is no reason not to decide this case according to the principles concerning the invention's substance. Examination of the changes introduced by Respondent 2 in its product, in the light of the guidelines formulated above on the question of the substance of the invention, leads in my opinion to the conclusion that Respondent 2 did infringe the element of "relative closeness."

I will explain my position.

33. I agree that a reading of the wording of the Patent, with reference to all its parts, leads to the conclusion that the physical distances between the sources and the pupils should be measured by normal and accepted yardsticks. The Patent instructs that the relative closeness should be measured at the stage of **manufacturing** the hologram, and not at any **earlier** stage when the closeness will be different and purely theoretical. The Patent does not instruct us to ignore various processes which require that the distances be enlarged by way of displacing the sources from the pupils. Although it is evident from the Patent that the inventor was aware that there may be a shift in wavelengths between the recording and playback stages, nevertheless there is no direction in the Patent to ignore, when measuring the distances, the displacement of the sources which was intended to compensate for the results of this wavelength shift. In Respondent 2's product, the sources were located at distances of 77 mm and 110 mm from the pupils. In a system with a focal length of 200 mm and a distance of 250 mm between the pilot's eye and the HUD, it is difficult to see how such distances could qualify as being "relatively close", according to the physical test which we formulated. Therefore, it must be concluded that Respondent 2 did not copy the protected invention literally.

However, the fact is that Respondent 2 did not change the pith and marrow of the protected invention. The phenomenon of angular displacement for wavelength shift, as well as the technique for compensating for it, were already known and accepted prior to the Patent. The Appellant's experts, Grey and Hesselink, submitted in their first opinion a basic book in the field of holographics which shows the mathematical equation for calculating the degree of displacement of the laser sources when

recording the hologram, which compensates for the results of wavelength shift (H. Smith, *Principles of Holography* (Wiley & Sons, 2nd ed., 1975) 62-63).

Mr. Brown, the Respondents' expert, did not dispute this (see, for example, his opinion at page 13).

As stated, the displacement of the sources was a "known addition" intended to make it possible to maintain the advantages of the invention. This may be deduced, for example, from a memorandum written by Mr. Brown which, although dated after the Patent, bears on the concept of the unimportance of the displacement of the sources to the operating principles of the holographic HUD, a concept which existed previously.

The document is entitled - "Initial Design of HUD Systems (1980)", and it was written in the Environmental Research Institute of Michigan (E.R.I.M.). The expert describes therein the stages of designing the holographic HUD, referring inter alia to the phenomenon of angular displacement and the aforesaid compensation technique. After discussing certain basic principles of designing the HUD, he describes the device's basic geometry whose aim is to maintain optical efficiency (the Bragg condition) over a wide field of view. In describing this geometry, the expert proposes (at pages 10-11) to ignore the angular displacement, because this phenomenon will be treated at a later stage:

> "With these basic considerations in mind the exact locations of the point sources are determined by the aberration and efficiency objectives. *Ignore for the moment the wavelength shift, it will be compensated for later.* The combiner is, in essence, a hologram and

thus meeting the objectives requires the recording geometry to approximate the reconstruction geometry. It is known that the combiner and fold mirror form a real image of the eyebox near the exit pupil of the relay lens. Also, if the efficiency is to be kept high, then the reconstruction rays must closely satisfy the Bragg diffraction condition across the entire fields of view. In order to satisfy these constraints, one point source (diverging) is located on the chief ray near the eyebox and the second one (converging) is located on the chief ray near the relay lens. Call the first beam the reference beam because this corresponds to the usual notion that the reference beam approximates the reconstruction beam. The second beam will be called the object beam. With this recording geometry the Bragg condition is met for all rays through the center of the eyebox (these rays exactly duplicate those of recording if the point source is exactly in the eyebox) while it is approximately met for rays originating in other locations of the eyebox. Furthermore, control of aberrations is achieved because the reconstruction (parallel rays in eyebox imaged near exit of relay lens) is not grossly different from the recording (point source near eyebox, point source near relay lens exit pupil)." (Emphasis added - M.S.)

After this basic description of the structure, the expert goes on to deal with the effects of wavelength shift, as follows (at page 11):

"The effect of the wavelength shift must now be compensated for in this basic geometry design."

As part of this treatment, the expert refers to two effects caused by wavelength shift: the first, its effect on the focal length of the hologram; and the second, its effect on the optical efficiency due to the angular displacement. To treat the first effect, the expert refers to an equation concerning the relationship between the wavelength shift and the focal length, a formula which, incidentally, also appears in the present Patent. To treat the second effect, the expert gives the equation for preserving the Bragg conditions.

34. This means that Respondent 2 moved the sources from the pupils precisely in order to maintain the advantages inherent in the construction geometry proposed by the Appellant. The sources were moved away from the pupils in order to compensate for the wavelength shift in recording and playback - not because the invention could not be performed when the sources were near the pupils, but precisely because the invention is **workable** when this closeness is **present.** The phenomenon of wavelength shift, and the technique for compensating for it, were known at the time of the Patent. Therefore, moving the sources away from the pupils was intended to solve a purely technical problem which was known; it did not reflect a new concept for manufacturing the hologram, but was intended to adapt a product which had this wavelength shift to the one described by the Patentee. To apply Lord Diplock's test in the judgment in *Catnic* [31] on the question of substance of the invention: if someone skilled in the art would be asked whether, in the light of the prior art, the inventor intended to deny protection against displacement of the sources intended to compensate for wavelength shift, we may presume that the answer would be in the negative. Any other answer would deprive

the Patent of its purpose, since it would allow the protected invention to be bypassed by means of technical changes in the wavelengths used to record and play back the hologram, while taking the substance of the invention.

The Respondents argued that to accept the Appellant's contention on the question of the substance of the invention is the same as accepting the functional interpretation, which we denied as aforesaid. This argument would be plausible if we viewed the substance of the invention as achieving optical efficiency over a wide field of view, by whatever method. However, it is untenable on the basis of the above analysis, which views the substance of the invention as a combination of the geometry of construction of the hologram with the optical means of correcting the aberration, which results in the advantages of optical efficiency enumerated by the inventor in the Patent description. The displacement of the sources in the Respondent 2's product was intended to maintain this geometry, when there is wavelength shift as described earlier. In terms of the substance of the invention, this displacement may be considered an unimportant variation which does not affect the substance of the functioning of the invention or its manner of operation.

35. The conclusion from all the foregoing is that in Respondent 2's product the sources are "relatively close" to the pupils, and this element therefore infringes the patented invention.

We must now resolve the question of infringement of the second element, i.e. whether Respondent 2's product has a means for compensating the optical aberration called axial astigmatism.

Means of Compensating Axial Astigmatism

36. As stated earlier, the Appellant succeeded in building a holographic HUD by means of a certain manufacturing technique (placing the laser sources close to the pupils). One of the advantages of this manufacturing process was that it resulted in optical aberrations on the focal plane of the hologram which could be compensated by means of conventional optical lenses. This compensation was made by introducing into the system optical aberrations which were identical to those obtained in the hologram, but in the opposite directions, so that ultimately the light reaching the pilot's eye remained free of aberrations. This balancing out is identical in substance to the elimination of optical aberrations in the human eye by means of spectacles. The location of the optical lenses which performed the task of compensation was fixed between the CRT screen and the combiner. The route of the light beams in the system can be demonstrated on Figure 1 above. The light emitted by the CRT (No. 176) is free of any optical aberrations; when passing through the optical relay lens (180), the aberrations in the hologram are introduced into it, but in the opposite directions; the aberrated light strikes a prism (182); and reaches the hologram (168), where the optical aberrations in the light beams are offset by the optical aberrations on the hologram's focal plane. From here the light continues to the pilot's eye, free and clear of aberrations.

Claim 1 of the Patent begins by defining the process of manufacturing the holographic combiner. We discussed this process earlier, in the first part of our consideration of the question of infringement ("relative closeness"). We will now deal with the second part of the Claim, which deals with the optical aberrations. This part of

the Claim refers to the structure of the system following the manufacture of the combiner: there are two optical aberrations in the combiner (axial coma and axial astigmatism), and they are compensated or corrected in the optical relay lens. In the words of the Claim:

> "... (The holographic lens) has a focal surface with axial coma and axial astigmatism, said display system having: first means along said axial ray between said object surface and said holographic lens to compensate said axial coma, and second means along said axial ray between said object surface and said holographic lens to compensate said axial astigmatism."

The combination of the manufacturing process of the combiner and the means of correcting the optical aberrations is the invention for which the Patent was granted.

37. Respondent 2 argued that in its product there is no "second means along the axial ray, between the image plane and the holographic lens, for compensating the aforesaid axial astigmatism". (The image plane is the CRT screen, and the holographic lens is the combiner). Learned Counsel for the Respondents and their expert agreed that the aforesaid optical aberration is present in Respondent 2's product, both in the combiner and in the optical relay lens, because their directions are opposite and they serve to eliminate the axial astigmatism in the light reaching the pilot's eye. However, according to them, the optical relay lens in the aforesaid product has no means of compensating for the axial astigmatism which is present in the combiner.

The point of the preceding discussion is as follows: According to the Respondents, the Claim should be interpreted to apply only to a combiner in which the optical aberrations are inherent. The optical aberrations are inherent in the combiner because its manufacturing process, by means of locating the sources near the pupils, makes these aberrations unavoidable. The Patent description also shows the aberrations as inherent in the hologram, due to the use of large nonaxial angles. Once the hologram is constructed in this way, the aberrations formed in it must be compensated by introducing opposite aberrations in the optical relay lens. In Respondent 2's product, the situation is different: it succeeded in correcting all of the axial astigmatism in the course of manufacture of the hologram, thus achieving a hologram which was free of this optical aberration. Now the other optical aberration, axial coma, was formed in the hologram, and this aberration must be compensated in the optical relay lens. However, the relay lens, which was designed to correct axial coma, created new axial astigmatism in the optical relay lens. For this reason, Respondent 2 was forced to reintroduce axial astigmatism into the hologram, in order to eliminate the axial astigmatism created in the relay lens. However, this axial astigmatism is new and different from the axial astigmatism appearing in the Patent and inherent in the hologram.

Learned Counsel for the Respondents agreed that the present Patent protects the invention of a product and not the invention of a process, but added:

> "Claim 1 which defines the invention... is a Claim for a product having several features, of which at least two are relevant to its manufacturing process... Just as the final product, in which the combiner was not made with the sources located as stated in the

> Claim, does not fall within the definition of Claim 1, so too the final product which did not have axial astigmatism in the combiner in the manufacturing process, which was corrected by the optical relay lens, also does not fall within the scope of the Claim... (Counsel for the Plaintiff) must persuade the court... that in the Defendant's product there was axial astigmatism in the combiner in the course of manufacture, which was corrected by the optical relay lens."

38. The lower court ruled that the dispute between the parties may be focused on the question of "whether the design process of the Defendant's product is irrelevant, provided that the final product is identical to the product claimed in the Patent." In answering this question in the affirmative, the Court held that:

> "We are dealing with a holographic HUD which has means of correcting certain aberrations caused in the holographic combiner by the fact that the sources of light are located relatively near the pupils. There is no reference here to any process whatsoever. I do not accept this literal "nit-picking" by Advocate Gabrielli (to the effect that aberrations not created by the manufacturing process of the hologram but by the optical relay lens are beyond the scope of the Claim). In the terms of the Claim, this interpretation creates interpretative 'aberrations' which do not exist on the face of the Claim."

The lower court therefore ruled that this element of the infringement is satisfied. The court did not have to refer to the whole series of contentions concerning the factual

dispute between the parties over the design and manufacturing processes of Respondent 2's product.

39. In the hearing before us, as in the summations, learned counsel for the parties expanded their discussion of the issue by arguments on questions of law and fact in regard to the element of compensation for axial astigmatism. Learned Counsel for the Appellant, Dr. Goldenberg, devoted a considerable portion of his statements to describing how the Appellant purportedly was denied a full and exact factual picture of the various stages of design of Respondent 2's product, and how Appellant's representatives made efforts to obtain and to decipher the relevant documents, even this with only partial success. Within this framework, Dr. Goldenberg presented a series of contentions concerning the duty of disclosure incumbent upon the parties' experts and the burden of proof of infringement, in its various aspects. The Appellant's experts examined the documents which were submitted to them and concluded that Respondent 2 failed in all its attempts to design a HUD whose manufacturing process differs from the one protected by the Patent, and it was ultimately forced to return to the Appellant's tried and tested prescription.

Mr. Goldenberg further contended that the Appellant itself knew, even prior to the Patent, that it was possible to build a combiner without axial astigmatism, by means of the bisecting technique, but it preferred to correct another aberration during the construction stage of the hologram - assymetric variation of astigmatism - and it therefore intentionally left axial astigmatism in the hologram. The Respondents' expert, Mr. Brown, admitted that this explanation is true. Mr. Gabrielli disputed this and showed that the Patent Specification (p. 22) states explicitly that the aforesaid technique

results only in reduction of the quantity of axial astigmatism but not its complete elimination.

In view of the subsequent discussion, we need not resolve these weighty questions concerning the disclosure of documents, the duties of experts, burden of proof, etc. However, it is noted that the Appellant did not refer to any formal ruling given by the lower court in regard to the disclosure of documents which may have been violated by the Respondents or anyone acting on their behalf. One must also understand the objective difficulties faced by the experts in examining Respondent 2's product, due to the fact that this product was still "on paper" only. As the lower court said:

> "The fact that the HUD forming the subject-matter of the Claim has not yet been manufactured caused difficulties not present in other patent proceedings, in which it is possible to compare the product which it is claimed infringes the Patent, in order to find out whether it actually infringes it or not. In the present case, the Plaintiff relied upon drawings and diagrams and other written material, according to which it is claimed, the Defendant will manufacture the HUD, and it is not surprising that the Plaintiff made considerable efforts prior to the hearing, with respect to disclosure of documents by the Defendant, as well as in the course of the hearings, when further documents were submitted by the testifying witnesses."

40. However, regardless of the answer to the factual dispute between the parties, it appears that one thing is indisputable: despite the various steps taken by Respondent 2,

when it reached the stage of manufacture of the HUD, its combiner had both of the optical aberrations mentioned in Claim 1 of the Patent, and these aberrations were balanced out by aberrations which are identical but opposite in direction in the optical relay lens. Although at times one may have understood from the pleadings of learned Counsel for the Defendants that the axial astigmatism was introduced into Respondent 2's hologram after it had already been built free of this aberration, nevertheless the conclusion that arises from the statements of the Respondents' expert, Mr. Brown, as well as from the statements of Mr. Gabrielli himself, is that the stage of a hologram free from axial astigmatism belongs, if at all, to the "design" process undertaken by Respondent 2. Mr. Brown admitted under cross examination in the lower court (p. 1710) that a combiner which had no axial astigmatism was unworkable, even assuming that it was possible to prevent the formation of axial astigmatism in the relay lens:

> "Q. Isn't it true, Mr. Brown, that this combiner T/70 (without axial astigmatism) was just not a workable combiner, you couldn't use it, even if you could design a relay that corrected for axial coma without introducing axial astigmatism?
>
> A. It probably would not have worked. It would have had to be modified. It was a starting point."

Mr. Gabrielli, too, in his Reply Brief, referred to Mr. Brown's description of Respondent 2's development stages as:

> "A description of the 'trial and error' by Respondent 2 from the moment it commenced the design of its HUD to the moment it arrived at the conclusion of the design."

This conclusion is also required by the very nature of the hologram as a completed product to which no changes can be made after it is manufactured. As Counsel for the. Appellant said:

> "Just as it is impossible to change a photograph after it has been exposed to light rays and the picture is developed, so too it is impossible to change a hologram after its exposure to laser beams and development. What one does is to design a new hologram, which is what Kaiser did, that has axial astigmatism as well as axial coma, and the hologram made by Kaiser already had axial astigmatism from the very outset."

Indeed, the Respondents' expert admitted that upon comparing the final products, the one protected by the Patent with that of Respondent 2, without any knowledge of the different design stages, one cannot discern any differences in this respect. This is evident from his cross examination (pp. 1614-1615):

> "Q: So the relay lenses in both final systems perform functionally the same in that they introduce axial coma and axial astigmatism, which is later cancelled out by the combiner?

A: Yes.

Q: So, Mr. Brown, isn't it correct that if we address ourselves to the final product only, without trying to inquire what led the designer to select the particular configuration of the combiner and the relay in both the Kaiser HUD and the patent, the relay constitutes a means of introducing aberrations of equal amount and of opposite sign to that which will be produced when light goes through the combiner. So the net effect in both systems is that those aberrations cancel each other out.

Would you agree?

A: I don't think you can ignore the reasons for the various aberrations in the various elements.

Q: Pardon?

A: I said, I do not think you could ignore...

Q: But assume that I can, for the purpose of my question. Would you then agree with my conclusion?

A: Then there is no choice, yes."

Learned Counsel for the Respondents argued that the question of infringement cannot be answered merely by comparing the final products. As he said in the Respondents' Reply Brief:

> "...The issue of the existence or absence of relative closeness in the location of the sources to the pupils is also not visible when comparing the final products: does this mean that this element, too, of the Patent Claim is meaningless?"

The above, I believe, demonstrates a certain inconsistency in the structure of the Respondents' pleadings concerning the distinction between the stages of design, manufacture and examination of the final product. The Patent in our case was granted for a product with certain features, one component of which was manufactured by a certain process. The first part of Claim 1 deals with the manufacturing process of the holographic combiner; the second part deals with the structure of the final product, i.e. one that comprises a combiner with both aforementioned aberrations and an optical relay lens with identical aberrations in the opposite directions. It is therefore obvious that insofar as the first part of the Claim is concerned, it is not possible to resolve the question of infringement by comparing the final products, because we are dealing with the manufacturing process and not with the product itself after it was manufactured. The second part of the Claim, concerns the structure of the product following the manufacture of the hologram, so there is nothing to prevent comparison of the final products in this case. The words of Judge Y. Cohen (as was his title then) in C.A. 700/88 [3], at page 761, are appropriate here:

> "The Respondent was able to prove prima facie that the principle on which the Appellant's heat receptor is based is so similar to the patented invention that the Appellant's product constitutes infringement of the substance of the Respondent's Patent. On this point, **it is irrelevant at what stage of manufacture and by which method** the hollow channels of the interior of the Appellant's heat receptor panels were made." (Emphasis added - M.S.)

Furthermore, everything stated above is insufficient to refer the Court to the process of the **design** of the HUD which preceded the process of manufacture itself.

41. The Respondents' strongest argument concerns the claimed difference between Respondent 2's final product and the patented invention. According to the Patent Description, the axial astigmatism in the hologram is corrected by cylindrical lenses in the optical relay, while the axial coma is corrected by tilting and/or decentering lenses (see Patent Specification - p. 4 line 10 et seq.; p. 9 line 16 et seq.; p. 10 line 5 et seq.; p. 21 line 7 et seq.; p. 27 line 2 et seq.). According to Mr. Gabrielli, the optical relay in Respondent 2's product has no cylindrical element to compensate for axial astigmatism. According to him:

> "When I correct the axial astigmatism pursuant to the Patent, I must put a cylindrical element in my optical relay, in every single HUD in every single aircraft... (whereas in Respondent 2's product) I correct the coma by means of other elements... tilted lenses. They correct the coma, and they create axial astigmatism which I correct in the

hologram. But I do not have in my optical relay lens a second means for compensating axial astigmatism."

Mr. Gabrielli demonstrated the above difference by a drawing which he submitted, according to which Plaintiff 2's product does not have the cylindrical element which is patented in the invention. Counsel for the Respondents also stressed the financial significance of this difference: the relay lens is lighter and cheaper, if other changes are ignored.

Counsel for the Appellant attacked the above presentation and submitted another drawing from which it appears that the optical relays are absolutely identical. Dr. Goldenberg further argued that the manner in which the axial astigmatism is introduced in the relay lens is meaningless. Respondent 2, he argued, created axial astigmatism in the relay lens by tilting and decentering existing lenses, which is a known and accepted technique for compensating axial astigmatism. The Respondents' expert admitted this. This technique also appeared in the Patent Specification.

In my opinion, there is no need to resolve this factual dispute, because even if we assume in favor of Respondent 2 that correction of axial astigmatism in its product is made by the second method above, it still infringes the Patent. The correct interpretation of the words of the Claim "second means for compensating..." includes, I believe, the means Respondent 2 contends that it adopted.

While the inventor chose to compensate axial astigmatism mainly by means of cylindrical lenses and to compensate axial coma by tilting and decentering, according to

the Patent Specification, still the question we must answer is whether, in the light of the professional know how, the inventor limited himself to this means only, and whether it was clear at the time that the introduction of axial astigmatism into the relay by tilting and decentering is, at the least, an equivalent method to the one described in the Specification, even if it was made incidentally to the correction of axial coma.

Counsel for the Respondents took pains to note that the Appellant did not contend in the present case that the substance of the invention was infringed, and that the dispute concerns interpretation only. However, as is evident from the preceding discussion, the issue of infringement is an integrated question, that concerns interpretation of the Patent and the scope of its application, including to fields which do not constitute literal copying of the invention's components.

As concerns the substance of the matter, the phenomenon of formation of axial astigmatism as a result of tilting and decentering was known. This is evident from the testimony of the Respondents' expert on cross examination (pp. 540-541):

> "We already knew from our previous studies that we could not remove that axial coma in the hologram, so we had no choice but to remove it in the relay lens, and it was obvious that if you tilt and decenter relay lens elements you will be able to remove the axial coma. We did that.
>
> Well that is fine, but when we tilted and decentered the relay lens elements they then caused axial astigmatism. So this problem that

> we have completely eliminated came back. Well we have to eliminate it again."

Incidentally, Mr. Brown confirmed under cross examination that in technical terms, it was possible to correct the axial coma even without creating axial astigmatism in the optical relay lens, but Respondent 2 chose to correct the first aberration in a way which also created the second aberration (pp. 1727-1728):

> "Brown: No, no, we chose not to correct the axial coma without introducing axial astigmatism, we allowed the axial astigmatism in the relay lens to be introduced.
>
> Dr. A.G.: Could you have done it? Just correct for the axial coma without introducing axial astigmatism?
>
> Brown: I believe that would have been possible.
>
> Dr. A.G.: It would have been possible.
>
> Judge: You think it's positive?
>
> Brown: I think it's positive, I think it is possible to design a relay lens that corrects the axial coma."

In the Patent Specification (in the description of the preferred embodiment, p. 9), there is also a reference to the fact that the tilting, which was intended to compensate the axial coma, results in axial astigmatism, and that this axial astigmatism together with the axial astigmatism created in the cylindrical element is offset by the axial astigmatism in the combiner:

> "The relay lens 26 includes cylindrical surfaces 63, 64, 65 and 66, which cause axial astigmatism in the intermediate image. Some axial astigmatism is also caused by the tilted glass plate equivalent of the prism assembly 24. The total axial astigmatism introduced... balances the axial astigmatism in the holographic lens 20."

It is evident from this, in my opinion, that the "means of compensating" mentioned in Claim 1 is not limited only to use of a cylindrical element, but also includes the use of tilting and/or decentering of the lenses, which create axial astigmatism in the optical relay lens, to the degree and in the direction created by the use of the aforesaid first means.

I also note that the financial considerations put forward by Mr. Gabrielli concerning the differences between the systems in terms of cost and weight, have not persuade me otherwise, particularly since this argument in itself does not prevent infringement.

42. Ultimately, we are left with the question posed by the lower court, namely, what is the relevance of the interim design processes to the infringement of the Patent?

The answer to this is clear - patent law protects the invention of a product or the invention of a manufacturing process, and does not concern protection of the invention of design processes, namely, the "trial and error" carried out by the inventor on the way to the manufacturing stage itself, or - as Dr. Goldenberg put it- until he arrives at the stage of designing the manufacturing process.

This is evident from the wording of the Law (see Section 3, which defines a "patentable invention" and Section 12, which lists the requirements of the Patent Specification), is supported by the authorities (e.g. Blanco White, *supra,* at pp. 45-46) and is also dictated by considerations of common sense.

43. The inescapable conclusion from the above analysis is that Respondent 2 infringed the Patent in question, by taking all the components of the protected invention. We will now deal with the next group of contentions, which concerns assessment of the validity of the Appellant's Patent.

The Validity of the Patent

44. The Respondents raised three contentions, acceptance of any one of which negates the Patent's validity: lack of novelty (Section 4 of the Law), lack of inventive step (Section 5 of the Law) and insufficient Description (Section 12 of the Law). The lower court did not resolve these questions, in view of its finding on the question of infringement, but it expressed the position, in brief, that the three contentions should be rejected. We cannot avoid the task posed by these questions, and we must therefore resolve both the legal issues and the relevant factual issues.

Before discussing the contentions themselves, we repeat, as we have already done several times, that whereas on the question of infringement the burden of proof rests on the Plaintiff (the Patentee), insofar as the validity of the Patent is concerned, once it has been registered, the burden rests on the Defendant (C.A. 244/72 [4], at p. 38; C.A. 314/77 [1], at p. 209; C.A. 665/84 [5], at p. 737). Although the Plaintiff may benefit from submitting evidence which reinforces the validity of the Patent, he is under no duty to do so; the mere fact that the Patent was granted is prima facie evidence that it is valid (C.A. 700/78 [3], at p. 763).

I will consider the Respondents' contentions in their sequence.

Lack of Novelty

45. Section 4 of the Law provides, in its relevant part, that:

"An invention is deemed to be new if it has not been published, in Israel or abroad, prior to the application date - (1) by written ... description, in such a manner that a man of the art can perform it in accordance with the details of the description;..."

The reason for this requirement is that if the patented invention was in the public domain prior to the date of the application, the protection of the law will not be accorded to it. If the invention was published previously, the applicant no longer has that consideration which is required of him in order to acquire a monopolistic right, i.e.

the disclosure of his invention to the public. The rules for testing the question of novelty, the existence or nature of some of which were disputed by the learned counsel for the parties, are derived from this reason.

The first rule is that in order to prove such prior publication as would be sufficient to negate the invention's novelty, it is necessary to submit a document which contains the invention in entirety, and it is insufficient to create a mosaic of information gathered from various separate documents in order to form a single comprehensive picture (C.A. 314/77 [l], at p. 209; C.A. 75/55 [6], at pp. 1992-1993). The logic behind this rule is that the combination of known things into a single collocation creates a new thing. The existence of novelty might be denied if "a subsequent publication contains or quotes a prior publication..." (C.A. 75/55 [6], ibid.) or where references were made from one publication to another (see for example Cornish, *supra,* at 123). In the case of a combination invention, some authorities hold that reference may be made to several documents, if someone skilled in the art would understand that they should be treated as a single entity. Opinions of this nature may be found in the United States:

> "References may be combined to anticipate claims when the references suggest doing what the applicant has claimed." (Lipscomb's Walker, *supra* (vol. I, 1984), at 391).

Blanco White is of a similar opinion, *supra,* at 60:

> "... the rule against 'mosaics'... is not entirely satisfactory; if taking two prior documents together they disclose the whole combination

> (and not merely separate parts of it) it is by no means clear that the combination has novelty. This situation may in particular arise where (expressly or by implication) one document refers back to the other. The rule against mosaics is not a rule;..."

Another rule is that the information which was in the hands of the public must have made it possible to perform the invention. This requirement is based on Section 4 of the Law and is mentioned in cases decided in the District Court (C.F. (TA) 1290/57 [12], at p. 119). A general description, from which one cannot learn how to perform the invention, is insufficient, and signposts that point in the direction of the patented invention are unsatisfactory. As Lord Sachs said in the English Court of Appeals:

> "To anticipate the patentee's claim the prior publication must contain clear and unmistakable directions to do what the patentee claims to have invented... A signpost, however clear, upon the road to the patentee's invention will not suffice. The prior inventor must be clearly shown to have planted his flag at the precise destination before the patentee." *(General Tyre & Rubber Co. v. Firestone Tyre & Rubber Co. Ltd.* (1972) [42], at 486).

The law in the United States is the same:

> "A prior printed publication to defeat a patent must describe the invention in such full, clear and exact terms as to enable any person skilled in the art to which it relates to practice the invention...

> Published descriptions leading up to but not fully accomplishing the desired end of the invention have been held not to anticipate. And if the prior disclosure affords no more than a starting point and does not teach the art how to practice the invention, it does not constitute an anticipation." (Lipscomb's Walker, *supra* (vol. I, at 347, 349-350); in Canada, see Fox, *supra,* at 131, 134-135).

A third rule, which is related to the preceding one, is that a patent will not be disqualified because of lack of novelty merely because the terms or words used in the patent are the same as the description in the prior publication. The test of novelty refers to the nature of what is described, not to its form or wording. As the scholar Fox said, *supra,* at 131-132:

> "While the language of a specification might be made, more or less, to fit the apparatus disclosed in a prior publication, that publication will not amount to anticipation if it does not suggest the patented invention... Similarity of language is not, of itself, sufficient to constitute a prior publication an anticipation. In each case the court must ascertain whether the prior document discloses the same invention as the subsequent patent which it is alleged to anticipate."

A fourth rule is that when assessing the prior publication, it is permissible to make use of the general technical knowledge as existed at the time, but it is not permissible to add in this manner any elements or components which are not mentioned in the prior publication (and which cannot be added according to the first rule above):

> "The description in the prior printed publication is to be read in the light of the knowledge possessed by persons skilled in the art to which the invention relates. Essential elements cannot be read into the description, nor can information which it does not give." (Lipscomb's Walker, *supra* (vol. I), at 348).

Another rule, that serves as a standard for this issue, links the questions of novelty and infringement to one another: if performing the contents of the prior publication constitutes infringement of the Patent, the patented invention is not novel:

> "The test for lack of novelty is essentially the same as the test for infringement; that is to say... a prior disclosure will invalidate if it contains a clear description of, or clear instructions to do or make, something that would infringe if carried out after grant." (Blanco White, *supra,* at 53. See also Fox, *supra,* at 134; Cornish, *supra,* at 122; Lipscomb's Walker, *supra* (vol. I), at 353).

However, a mere possiblity of such an infringement is insufficient; it is necessary to show that following the prior publication would lead necessarily to infringement of the patent (see *General Tyre* [42], *supra,* at 486).

46. The Respondents submitted two publications which they contend contain all the elements of the patented invention. The first publication is an article written by an employee of the Appellant's research laboratories, which was published in August

1973 in a seminar on "Applications of Geometrical Optics" of the Society of Photo-Optical Instrumentation Engineers (hereinafter - the SPIE document).

The lower court ruled in respect to this publication that:

> "...[I]t does not contain a description of the lens system and other elements of the invention. Nor does the document contain any instructions regarding the location of the sources. The Defendant's expert held that this was unnecessary because, based on the laws of physics, any professional would recognize *immediately* that placing the sources near the pupils is the correct solution. I do not accept this contention. This means that it is impossible, on the basis of this document, to design a holographic HUD such as the patented HUD. Therefore, this document is not a prior publication".

The other publication submitted by the Respondents is a report from the Appellant's research laboratories titled "Holographic Lens for Pilot's Head-Up Display". The parties called this document the "August 1974 report", after its date of publication, or the "NADC report", after the body for which the report was prepared. The lower court said that this document "does not contain all the components of the holographic HUD, and it should therefore not be considered a prior publication which makes it possible to build such a HUD".

47. The main contention of Respondents' counsel was that the court erred in comparing the contents of the publications to a working holographic HUD. The prior

publication should be compared to the invention defined in the Claims, and according to the Respondents, the Patent does not protect a working HUD, but only presents a design approach to building a HUD. This contention is related to the Respondents' contentions as to insufficiency of Description, which will become clearer later. According to the Respondents, the level and detail of disclosure of information in the above documents is similar to that in the Patent, i.e. information describing only a design approach to constructing the HUD. To prove the contention of lack of novelty, the Respondents submitted in the lower court a schedule compiled by one of their experts (Mr. Colburn) showing the components of the invention listed in Claim 1 of the Patent alongside the page numbers of the prior publications in which, they contend, these components appear.

48. First, it must be said that the above presentation is insufficient to satisfy the burden of proof resting on a party claiming lack of novelty. Counsel for the Appellant is correct in saying that it is insufficient to rely on a schedule as aforesaid, as if it is proof per se, without examining the documents themselves and showing how it was possible to perform the protected invention on the basis of their contents. The Respondents should have shown that the combination, as described in the Patent, can be learned from the publications.

But apart from this, examination of the aforementioned documents shows that what they describe does not teach that which is contained in the Patent, and that they refer at best to interim stages of a process fraught with obstacles, only at the end of which was it possible to arrive at the patented combination.

The above mentioned SPIE document is titled "The Use of Ray Intercept Curves for Evaluating Holographic Optical Elements", and as its name indicates, all it contains is a presentation of means to measure and evaluate various problems in the process of finding concrete solutions. The document proposes shifting the sources until a wide field of view is achieved, but without indicating their new location (p. 101). Even if the Respondents' witness is correct in contending that the aforesaid result is possible, according to the laws of physics, only when the sources are moved close to the pupils, the Respondents nevertheless failed to show that this solution was known, particularly since - as stated earlier - it is not possible to add to the prior publication in this way elements which are not mentioned in it. Moreover, the Respondents did not prove that at the time of the article they were able to overcome the optical problems caused by shifting the sources to the pupils. The article indicates that it was possible to use a relay lens to correct aberrations, but notes that a solution in this direction is in the research and development stages (p. 103). Most important of all, the author of the document expressly mentioned the complex problems which still needed to be studied and solved in order to achieve the combination described in the Patent (p. 102):

> "Once the configuration has been chosen and the hologram has been bent (Ref. 2) to provide high efficiency across the field of view, one has to find out what the image of quality is like. The things that have to be studied are:
>
> 1. Tilt and curvature of the tangential and sagittal fields.
> 2. Efficiency across the pupil and across the field of view.
> 3. The type and size of aberrations.

4. The system errors and their relationship to the aberrations.

In the example of the HUD system, resolution is no problem, the eye pupil size is small enough that a sharp image is always observed. Rather, the problem is that the image direction changes as the eye pupil moves within the system pupil area. Therefore, the primary system errors are collimation error and binocular disparity. Other errors, such as distortion and chromatic dispersion may also be important, but will not be discussed here."

The August 1974 report is longer, more detailed and more concrete than the first publication mentioned above, and it already recognized the need to shift the laser sources to the pupils. However, this document, too, does not deal with the subject of **combination,** i.e. building the hologram with aberrated laser beams in a way which creates **specific** optical aberrations on the plane of the hologram which can be offset by a **specific** optical relay lens, while other aberrations are treated already in the recording stage. These subjects and others will be studied in the future, after technological development, as the report says:

"The above steps totally specify the continuous lenses studied in this program. With this basic design, ray tracing techniques are used to analyze the system and evaluate the image quality. This analysis considers the characteristics of the hologram and its imaging properties; it does not consider the effects on image quality of adding a correcting lens. In the preliminary system design (Section III), we

have considered the paraxial specifications of the relay lens, and the effects on overall system distortion of a paraxial relay lens.

The final system design is a very complex task, requiring consideration and balancing of all parts of the system:
hologram geometry, construction beam characteristics, and properties of a nonparaxial, thick, compensating relay lens. This final design task is presently scheduled for the proposed Phase 3 program." (p. 29).

"... We recommend a transmission system for the next stage of technology development. In particular, the symmetric transmission continuous lens is chosen for the preliminary system design. The final choice of configuration for the system should be made only after further technology development and assessment of the complex design requirements, which involves many tradeoffs and includes human factors as well as purely technical considerations.

The general conclusion is that either a reflection or a transmission geometry could be designed that would meet the system specifications, provided that a thorough unified design procedure is followed, utilizing ordinary, refractive optical elements both in the hologram construction beams and in a complex, correcting relay lens." (p. 59).

It would not be superfluous to add the comment of the Appellant's experts that the report indicates directions of thought about construction of the hologram, which not only did not lead to the concrete solution embodied in the invention, but which even moved the scientists away from that solution. For example, the report devoted an extensive discussion to treatment of a particular optical problem (distortion). If any attempt had been made to correct this in the relay lens together with the other aberrations (astigmatism and coma), it would have made it difficult to achieve the described combination, even to the extent of complete failure.

To summarize, the Respondents failed to prove their contention of lack of novelty.

Inventive Step

49. Section 5 of the Law defines inventive step as:

> "...a step which to an average man of the art does not appear obvious in the light of information published, prior to the application date, in the ways indicated in section 4".

This requirement for the validity of a patent is wider than the requirement of novelty, the reason being that it is not enough that the product or process be something new which has not yet been disclosed to the public, but to deserve the protection of the law, it must make a material contribution to the field, which justifies granting a monopoly to the patentee while restricting the freedom of others. Here again, several basic rules are derived from this.

One basic rule concerning the question of inventive step is that it is necessary to examine the total art in the relevant field, and for this purpose it is permissible to join prior publications together to form a comprehensive picture (C.A. 314/77 [l], *supra,* at p. 209). However, it must be remembered at all times that this joining together must also be obvious to the skilled person at the relevant time; that if an inventive step is required for this purpose, particularly in the case of collocations of fragments of information from various sources, the composite picture is not obvious and it cannot be said that there is no inventive step in the patented invention:

> "... the man-in-the-art... must be considered as having the whole of the available art before him and in particular as reading two or more documents together, if for any reason it would be obvious to do so... If... it is necessary in order to arrive at what is claimed to make a 'mosaic of extracts from annals and treatises,' it becomes difficult to resist the inference that an inventive step was needed: although for the purpose of showing obviousness it is permissible in our law to make a mosaic out of the relevant documents, the mosaic must be one which 'can be put together by an unimaginative man with no inventive capacity'...
>
> The warning against making a 'mosaic' makes good sense, if the making of a mosaic is considered in its true sense of making a pattern from little bits of material with little or no shape of their own

> - so that the pattern is the artist's, not something inherent in the pieces..."

(Blanco White, *supra,* at 81-82; Cornish, *supra,* at 132). The law in the United States is the same: 60 Am.Jur. 2nd *supra,* at para. 177; G. McClung, "Combining a Variety of Prior Art References to Invalidate a Patent Under 35 U.S.C. para. 103," 25 Idea (1984) 83.

As for the person to whom the question of inventive step is directed, i.e. as the Law states, "an average man of the art", i.e. a person (or a team of persons, if necessary - C.A. 665/84 [5], *supra,* at pp. 747-750) who is familiar with all aspects of the relevant scientific field, but who does not apply any inventive thinking. This fictitious (or "reasonable") man may acquire a different character in different professional or scientific fields, depending on their technical or research nature. In criticizing the traditional English test of the "ordinary workman", Blanco White, *supra,* at 90, proposes that the person addressed by the Patent should be the person or team whose help would have been called upon to solve the difficulties on which the dispute is centered:

> "It is many years... since the making of technical improvements was left by employers to their workmen; nor can there be many industries in which technological developments are introduced into production at all without preliminary trial as a development or a research project... Clearly, then, the 'ordinary workman' can no longer be the test; the question remains, who is? In principle, it would seem clear that the proper people to think of in judging obviousness are those

> who would in practice be called upon to solve problems of the sort concerned. In a relatively unsophisticated industry, that could be the manager or a man in the tool-room or drawing-office; but in the sort of industry where manufacturing concerns keep research departments, that is presumably where unsolved problems should end up. Accordingly, anything that an industrial research team would succeed in doing as a matter of routine ought prima facie to be considered obvious."

A third rule is that a step need not be big in order to be not self-apparent: there must be an inventive step, but it is sufficient if it is modest and small; the simplicity of the invention will not be an obstacle to the validity of the patent (C.A. 75/55 [6], *supra,* at p. 1994; C.A. 314/77 [1], *supra,* at pp. 208-209; Terrell, *supra,* at 135-136).

Another rule which the courts have adopted and which is related to the previous one is that one should avoid analyzing the prior information with the aid, even sub-consciously, of the new information presented in the patent. As Judge Berenson said in C.A. 75/55 [6] supra, at pp. 1993-1994):

> "It is easy to be smart after the fact and say 'There is nothing new in this - anyone skilled in the art could have made it without difficulty'. However, one should not examine the matter retroactively, after the respondent's invention, but as it appeared before the invention became known". (See also his remarks in C.A. 528/61 [7], *supra,* at p. 2495).

Further on in the above judgment appears a quotation from Lord Moulton in *British Westinghouse Electric and Manufacturing Co. Ld. v. Braulik* (1910) [43], at 230:

> "I confess that I view with suspicion arguments to the effect that a new combination, bringing with it new and important consequences in the shape of practical machines, is not an invention, because when it has once been established, it is easy to show how it might be arrived at by starting from something known, and taking a series of apparently easy steps. This *ex post facto* analysis of invention is unfair to the inventors and in my opinion it is not countenanced by English Patent Law..."

See also the references cited by Terrell, *supra,* at 136- 137.

As was ruled in an American case -

> "To imbue one of ordinary skill in the art with knowledge of the invention in suit, when no prior art reference or references of record suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher..." (W. *L. Gore & Assoc. Inc. v. Garlock, Inc.,* [18] (1983), at 1553. Starting from October 1982 all appeals in patent matters are heard by a single appeals court - The Court of Appeals for the Federal Circuit).

50. The uncertainty surrounding the question of assessment of inventive step, as well as the reluctance of the courts to consider technical matters only, have led to the development of subtests which refer the judge to objective considerations that are neither technical nor economic in nature and that serve as possible indexes on the question of inventive step. The importance of these subtests was noted by the American Supreme Court in the leading case, *Graham v. John Deere Co.* (1966) [19], at 35-36:

> "These legal inferences or Subtests do focus attention on economic and motivational rather than technical issues and are, therefore, more susceptible of judicial treatment than are the highly technical facts often present in patent litigation. See Judge Learned Hand in *Reiner v. I. Leon Co.,* 285 F. 2d 501, 504 (1960). See also Note, Subtests of 'Nonobviousness': A Nontechnical Approach to Patent Validity, 112 U. Pa. L. Rev. 1169 (1964). Such inquiries may lend a helping hand to the judiciary which, as Mr. Justice Franfurther observed, is most ill-fitted to discharge the technological duties cast upon it by patent legislation. *Marconi Wireless Co. v. United States,* 320 U.S. 1, 60 (1943). They may also serve to 'guard against slipping into use of hindsight,' *Monroe Auto Equipment Co. v. Heckethorn Mfg. & Sup. Co.,* 332 F. 2d 406, 412 (1964), and to resist the temptation to read into the prior art the teachings of the invention in issue."

These tests, also called "secondary considerations", are not conclusive with regard to resolving the issue of inventive step, but they do provide indications and assistance

for its resolution, if they are cautiously applied in the unique circumstances of each individual case. (Regarding the various judicial approaches to these subtests in the United States, see D.S. Chisum, *Patents - A Treatise on the Law of Patentability, Validity and Infringement* (Vol. II, 1988), see. 5.05; .G. McClung & R.G. Bliss, "So-Called 'Secondary Considerations' Related to Nonobviousness of an Invention", 26 Idea (1985) 95. For criticism of some of the subtests, see D. Whelan, "A Critique of the Use of Secondary Considerations in Applying the Section 103 Nonobviousness Test for patentability", 28 Boston Coll. L. Rev. (1987) 357.)

Naturally, if the Patent concerns a more complex and sophisticated technology, there will be a stronger tendency to use these tests (e.g., *Photo Electronics Corp. v. England* (1978) [20], cited by Chisum, *supra),* but this does not make them exclusive considerations.

Several subtests may be of help in the present case:

The first is the test of "long felt need", which refers to the period prior to the Patent, in which we ask the question, did the patented invention present a solution to a problem for which no solution could be found for a long time, even though attempts had been made to solve it; for if the transition from the prior art to the invention was obvious, skilled professionals would have found a solution for the vexing problem before the inventor did so. Reference to failed ; attempts by various parties in the relevant field, particularly large organizations with research and development facilities, who attempted to find the solution which was eventually patented by the

inventor, may strengthen the significance of this test (see e.g. 60 Am. Jur. 2nd, *supra,* at 157-159). :

A supplementary test to "long felt need", which refers to the period after the Patent was granted, is the test of the commercial success of the patented product or process (C.A. 433/82 [2], at p. 540). However, a clear distinction must be made between commercial success arising from the advantages of the invention itself and commercial success arising from market forces caused by factors external to the invention, such as promotion and marketing, shortages or surpluses of other products or raw materials, etc. This distinction might perhaps explain the tendency of the English courts not to recognize the test of commercial success if the requirement of "long felt need" is not satisfied as well (see the references cited by Blanco White, *supra, at* 102, and criticism of this approach by Cornish, *supra,* at 136). In any event, this does not lead to the conclusion, as argued by Mr. Gabrielli, that the opposite is the case, i.e. that a "long felt need" unaccompanied by commercial success is not an indicator of inventive step.

Another subtest concerns the reaction to the invention among the community of professionals in the relevant field. If the invention was received with surprise or described as revolutionary by the professionals, it will be difficult to consider it obvious (60 Am. Jur. 2nd, *supra, at* 160; Blanco White, *supra,* at 111. See also the article cited in the *Graham* case [19] *supra,* at 1181-1182).

Finally, an inventive step may be indicated if the invention was copied by competitors in the field, such as the defendant, who by his acts:

> "... gives the [invention] the tribute of its imitation..."*(Diamond Rubber Co. v. Consol. Tyre Co.* (1910) [21]; 60 Am. Jur., *supra, at* 160; Whelan, *supra,* at 371-372).

51. There was a dispute between the parties to this Appeal as to the scope of the prior publications on the basis of which the question of inventive step is to be decided. Following a certain sequence of events during the proceedings in the lower court, concerning the procedural agreement between the parties in regard to the submission of opinions by their experts, the lower court gave an interim judgment which limited the scope of the evidence on this question. The Court ruled that only those documents called the Farand and Macauley documents would be used on the question of inventive step, but not the two publications which were examined on the question of novelty, i.e. the SPIE document and the August 1974 report. In their summation before the lower court, the Respondents again relied on the latter two documents in connection with their claim of lack of inventive step, and the Court commented on this in its judgment, as follows:

> "During the hearing, the Defendant attempted to widen its arguments regarding lack of inventive step to include the documents considered on the subject of 'lack of novelty' above. In my decision I did not allow the matter to be widened and I will not allow any arguments in the summation contrary to this ruling."

As to the matter in hand, the lower court rejected the argument of lack of inventive step, referring to the first publications mentioned above. The Respondents did not argue

before us against this finding, nor did they make any arguments on the basis of the Farand and Macauley documents, but referred again to the SPIE document and the August 1974 report.

Dr. Goldenberg objected to the reference to these two documents for three reasons: One - if the Respondents were seeking modification of a ruling made by the lower court, they should have submitted notice of a counter-appeal, as provided in Section 434 of the Civil Procedure Regulations, 1984, and since they did not do so, they cannot be allowed to attack the aforesaid ruling at the present stage; two - the lower court was correct in deciding to limit the documents, and its ruling should not be interfered with; three - since the Appellant, as a result of the aforesaid ruling, was denied an opportunity to cross-examine with respect to those documents, there are no factual findings before the appellate court on the basis of which the issue can be resolved.

Mr. Gabrielli proposed a different interpretation of the aforesaid Section 434 and disputed the Appellant's other arguments. The Respondents mentioned the two disputed documents in their Statement of Defense, in connection with the argument of lack of inventive step, and these documents were before the lower court at all stages of the proceedings. According to Mr. Gabrielli, whereas the aforesaid interim ruling referred to the stage of the hearing of evidence, it does not affect the stage of drawing conclusions by the Court, at which the Court may make a decision even if no witnesses were heard. In support of this argument, Mr. Gabrielli quoted Judge Barak in C.A. 433/82 [2] *supra,* at pp. 537-538:

> "The finding whether a certain step does or does not appear obvious to the average person skilled in the art is not a purely factual finding, but a conclusion which the Court draws from the evidence before it... The evidence should be submitted to the Court in the normal manner, but the conclusion is drawn by the Court on its own. It is not a matter for experts - although they may occasionally be of help... but it is a matter for the Court itself... Accordingly, the Court is under no obligation to hear expert witnesses on the question, if an average person skilled in the art would have seen the invention as obvious."

Counsel for the parties also disputed the significance of the above passage with respect to the present case, while Dr. Goldenberg referred to statements made in a decision by this Court in a petition for rehearing in the above case (D.N. 20/85 [8]), and suggested the need to distinguish, with regard to the hearing of witnesses, between subjects of different technological levels.

52. We may leave the important legal questions which were raised unresolved, since I am satisfied that in the present case sufficient evidence was submitted that the SPIE document and the August 1974 report do not establish the argument that the Appellant's invention lacks an inventive step. The application of the subtests mentioned above leads to this conclusion. As for the dispute concerning Section 434, I would note only that even if the Appellant's argument is well founded, nevertheless the appellate court has broader discretion in the matter (e.g. Sections 436 and 524 or 526), which prevent an excessively formal delimitation of the proceedings because of a procedural defect.

53. As we have seen in the section on the requirement of novelty, the SPIE document and the August 1974 report describe the basic problems faced by the designers of the holographic HUD. The first document is a short article proposing a means for measuring the optical efficiency of the hologram. The second document, which was published later, was already more concrete, but it still left many questions to future research and development. Even if it is assumed that it was obvious to refer to both documents together, the total picture which arises from them is still that the persons skilled in the art were unable at that time to achieve the longed for combination that the Appellant ultimately achieved. The concept of locating the sources near the pupils did exist, as did recognition of the need to correct optical aberrations by means of an optical relay lens. However, they did not know how to do this, i.e. which aberrations could be corrected during the recording of the hologram and which aberrations could be left in the hologram to be corrected by the optical relay lens, and how this was to be done. The entire subject of the combination, which is the essence of the patented invention, had not yet been studied and had certainly not yet been tried, and as is evident from the aforementioned documents, required extensive further efforts in the form of technological development, research and experimentation.

Therefore, it cannot be said that the transition from the knowhow embodied in those documents to the knowhow embodied in the invention required merely the application of known scientific principles which, even if they had required experimentation and testing, were still obvious to those skilled in the art. It was not a lack of sufficient technical detail, the completion of which was obvious; what was lacking were the essential technological solutions for achieving an efficient combination

of the two parts of the HUD, without which they had nothing. The Patent protects this combination. The following passage from the English case law, cited by Blanco White, *supra,* at 99, expresses this succinctly:

> "It has been said that 'the mere application of a known [scientific] principle to a use or subject-matter admittedly within its scope will not involve an inventive step,' although 'the result may be otherwise if it be shown that in such application special problems or difficulties were presented which the patentee... was the first to overcome.'"

It is not superfluous to mention here the courts' skeptical approach with regard to publications, which are "mere paper proposals," and which in hindsight, through the eyes of the inventor, can be easily linked to the invention:

> "It is much more difficult to show that a 'mere paper proposal' is part of the ordinary technician's standard mental equipment. Even as specific citations, unworked proposals - mere 'laboratory toys' - are treated with suspicion. Occasionally they may form the basis for a finding of obviousness, perhaps because they come very close to being anticipation. But they demand answer to the standard question: are they addressed to the same problem which the patentee solved? If so, why did they not lead to earlier discovery of his solution? It is in relation to such cases that the judges have warned against viewing the matter with the advantage of hindsight." (Cornish, *supra,* at 131; Blanco White, *supra,* at 100-102).

Moreover, we have seen that some of the solutions proposed by the experts in the aforesaid documents "taught away" from the solution embodied in the Patent, and this is a technical consideration which strengthens the conclusion that the invention was not obvious (see, e.g.: *United States v. Adams,* (1966) [14], at 51-52; 60 Am. Jur. 2nd, *supra, at* 152).

54. The subtests applicable to the question of inventive step strengthen our conclusion. As stated earlier (paras. 6-10), for a long time there was a real need for the development of a head-up display system of high optical efficiency. Various attempts were made by the leading companies in the field to design such a system, some in the conventional HUD field and others in the holographic HUD field. None of these attempts yielded the optimum results that were ultimately achieved by the Appellant, which was granted the Patent for the unique combination which made these results possible. Mr. Gabrielli argued that the Appellant did not prove that its product was a commercial success and that, therefore, it cannot rely on the test of long felt need. However, as stated earlier, there does not necessarily have to be a connection between the two. Furthermore, at least according to the evidence submitted before us, the Swedish Air Force has evidently purchased the Appellant's product for its advanced aircraft.

Dr. Goldenberg submitted articles from the professional literature which demonstrate the reactions of the professionals to the Appellant's invention. For example, an article titled "Diffraction Optics HUD Improves Cockpit Display", which was published in the journal, Defense Electronics (April 1983):

> "The holographic head-up display developed by Hughes and chosen by Saab-Scania for use in Sweden's next-generation lightweight agile fighter, the JAS 39 Gripen, is said to be as significant a breakthrough in avionics as was the invention of the conventional HUD itself."

Similar statements appeared in another article in International Defense Review, April 1983. Incidentally, regarding the use of professional literature in the context of this test, see *In re Piasecki* (1984) [22], at 1474.

The Respondents did not dispute the contents of the above publications.

Finally, Respondent 2 chose to take the Appellant's invention and use it to manufacture its products. This, too, is an indication, as we said earlier, that the invention is not obvious. As the Federal Court of Appeals said:

> "That Dennison, a large corporation with many engineers on its staff, did not copy any prior art device, but found it necessary to copy the cable tie of the claims in suit, is equally strong evidence of nonobviousness." *(Panduit Corp. v. Dennison Mfg. Co.,* (1985) [23], at 1099).

This decision was overturned by the Supreme Court for reasons having nothing to do with the aforesaid.

Accordingly, the conclusion is that this argument, too, is rejected.

Insufficient Description

55. Section 12 of the Law requires that:

> "The specification shall contain... a description of the invention, with drawings as may be necessary, and a description of the manner of performing the invention such that a man of the art can perform it according thereto."

The purpose of the requirement of sufficiency of the Description is to ensure that at the time of the application the inventor actually possessed the invention which he sought to patent. This requirement also serves the informative function of the patent laws: the interested public has the right to know the scope of the invention and how to perform it, so as not to prevent the encouragement of research in the relevant field, and to allow others to enjoy the invention following expiration of the monopoly, or even earlier, for example, to permit utilization of the invention under a license granted by the patentee.

The sufficiency of the Description is tested against the general professional knowledge in the relevant field or fields at the date of the application: the inventor does not have to give details concerning what this knowledge comprises. The Law uses the term "a man of the art," but this does not mean that the test is any different from the "average man of the art" applied in the issue of inventive step. In both instances, the

standard and level of the person will be determined by the scientific or technical nature of the relevant field and by its degree of complexity. The "man of the art" may be a simple laborer, but in this modern technological world he will often be a scientist with advanced academic qualifications:

> "... it must be kept in mind that the skill of the mechanic in most of the arts is much greater today than in earlier periods. As technological knowledge becomes available to more people and as the general levels of education become higher, it is natural that the mechanic or worker in the arts has greater skill than formerly." *(Falkenberg v. Edward Co.,* (1949) [24], at 429).

> "The idea of giving a patent specification to an ordinary workman (whatever that may mean in relation to the nascent industries of today), and allowing him to hold up production whilst he tried to put it into practice, is completely unreal under present conditions: technical changes are not now made so simply. In fact, though the 'ordinary workman' is still cited in court from time to time, no pretence is nowadays made of addressing patent specifications to him." (Blanco White, *supra,* at 130-131).

As with respect to Section 5 of the Law, here too the person may be a team of skilled persons from the branches represented by the subject of the patent (C.A. 665/84 [5] *supra,* at pp. 747-750, and see the references cited there). When an aspect of the invention which is related to a specific field of expertise is being tested, the addressee will be the skilled person belonging to that field:

> "When an invention, in its different aspects, involves distinct arts, that specification is adequate which enables the adepts of each art, those who have the best chance of being enabled to carry out the aspect proper to their specialty" *(Re Naquin* (1968) [25], at 866; Lipscomb's Walker, *supra* (Vol. III), at 240-241).

The inventor must include in the Description the data which will allow the invention to be performed by the persons skilled in the art, without them requiring any inventive step to do so and without having to "add something of their own" (C.A. 75/55 [6], *supra,* at p. 1995). This means that -

> "If... they are to do something the like of which has never been done before, he must tell them how to do it, if a reasonably competent workman wold not himself see how to do it on reading the specification..." *(Edison & Swan Electric Light Co. v. Holland* (1889) [44], per *Lindsey LJ.,* at 280; Terell, *supra,* at 87; Blanco White, *supra,* at 128- 129).

However, it is acceptable if the performance of the invention requires trial and error not exceeding what is reasonable under the circumstances (C.A. 665/84 [5] *supra,* at p. 750, and the citations referred to there. This is the law in the United States as well: 60 Am. Jur. 2nd, *supra,* at 323- 324; and in Canada: Fox, *supra,* at 172). The skilled person is certainly not exempt from performing any calculation which may be required to build the invented product. As Terrell writes, *supra,* at 89:

"... a certain amount of designing and calculation has to be carried out before a machine can be built, and the degree of knowledge requisite to perform such operations must be presumed in the person to whom the specification is addressed."

The contention of lack of sufficient Description may be weakened if the party asserting it took for himself the invention taught by the inventor. As the Supreme Court of the United States stated in a famous case from the last century:

> "A great deal of testimony was introduced by the defendants, to show that the patentee had failed to describe his invention in such full, clear and exact terms as to enable persons skilled in the art to construct and use it. It seems to us that the attempt has failed. When the question is, whether a thing can be done or not, it is always easy to find persons ready to show how not to do it. But it stands confessed that the thing has been done... If the thing could not be understood without the exercise of inventive power, it is a little strange that it should have been so easily adapted to the looms on which it has been used and produced such striking results." *(Webster Loom Co. v. Higgins,* (1881) [26], at 586-587).

A contention of lack of precision in the Description is also not always consistent with corresponding contentions of lack of novelty and lack of inventive step, since those contentions are based on the fact that the skilled persons would have been able to

perform the invention, which was known and obvious, with no difficulty whatsoever. As the court said in the *Webster Loom* case [26], *supra,* at 587:

> "It is worthy of remark, in this connection, that the defendants, in their answer, state it as a fact that, prior to the alleged invention of Webster, looms containing lays having shuttle-boxes rigidly attached were publicly known and described in certain English patents:.. and they aver and insist... that the application and use of the two things together... were obvious and required no invention; and that, therefore, the alleged invention of Webster was well known and constituted a part of the well known state of the art. This averment in the answer... does not seem to tally very well with the allegation that Webster has failed to point out, in his patent, how to use and apply his invention and that it required further invention to use and apply it." (See also: Janicke, "Litigation Impact of the Prosecution Attorney's sec. l 12 Decisions," 6 A.P.L.A.Q.J. (1987) 206, 207).

Nevertheless, it should be remembered that the above considerations must be tested within the concrete framework of the case at issue, which may show that there is no contradiction between the infringement or the contentions of lack of novelty and lack of inventive step on the one hand, and the contention of insufficient Description on the other hand. For example, it is possible that the inventor actually lacked the knowhow necessary to perform the invention, or that he had the knowhow but it was not disclosed in the Patent, while the defendant in time discovered this knowhow on his own.

56. The Respondents do not contend that the Appellant did not have the knowhow necessary to build the invention, and no contention was raised before us that the invention is impracticable, i.e. that it cannot be performed. The Respondents' contention is that the lens system of the optical relay, which forms a part of the invention, is not specified in a way which makes it possible to perform the invention. In the Patent Specification (pp. 9-13), the lenses are described, with accompanying drawings, by their type, their location and their function in the relay, but the inventor should have also supplied detailed prescriptions of the lenses' exact physical dimensions, i.e. their exact size, thickness etc. The inclusion of this information in the Specification was a simple matter, as the Respondents' expert noted in his opinion -

"Minimal effort would have been required to list that prescription".

In the absence of such a prescription, it was not possible, so it is contended, to perform the invention, other than with the aid of a "ray tracing" computer program, which made it possible to calculate the exact dimensions of the optical elements quickly. Since the system combines conventional and holographic optics, computer software for conventional optical elements was insufficient, just as one could not use software dealing with only holographic optics. A program which combines the two fields was required. There is no dispute between the parties that calculating the dimensions of the lenses without a combination program as aforesaid would have taken a very long time, possibly even years (see testimony by the Appellant's witness, at pp. 2158-2159 of the record of the hearing before the lower court). There is also no dispute over the lower court's ruling that on the date the Patent was issued, only two

combination programs existed, one belonging to the Appellant and the other at the aforementioned E.R.I.M. Institute.

The dispute centered on two issues: the availability of the programs, of both the ordinary and combination variety, to the persons skilled in the art, and the degree of effort required to write a combination program from the ordinary programs. The court did not discuss these questions expressly, stating only that:

> "The Specification is not a technical document which must exempt the skilled person from all design and other work. What is required is that the principles of the invention must be clear and that the average person skilled in the art should be able to perform the invention. The program, whose absence in the Specification is complained about by the Defendant, does not have to be in it at all".

57. I do not accept the argument that the exact dimensions of the lenses in the optical relay should have been specified in the Patent. We have already noted that the Patent refers to optical display systems built with the unique combination embodied in the Patent, and it is not limited to a specific product with specific physical dimensions only. Taking only the HUD as an example, the specific dimensions of any such product are determined by the dimensions specified by the orderor, i.e. depending on the dimensions of the aircraft in which it is to be installed. For this reason, the Patent also contains no instructions regarding the exact physical dimensions of other components of the invention, such as the holographic combiner. All that the Patent describes is the subject-matter of the invention, i.e. the combination of a combiner built in a certain way

and operating in a certain way, with a relay lens operating in a certain way. The American case law on this point is eminently appropriate:

> "The utmost precision in the description of the machine is not to be expected, nor is it essential. Parts of machinery and processes generally known need not be described. A wedge, pulleys, rollers, rack and pinion, and other things, known to all mechanics, will be supplied by the machinist without stating their size or structure. Nor is it essential to state the proportionate parts of a machine, nor the velocity of its operations. These are matters of adjustment for the eye and judgment of the constructor. Whether a machine be large in its parts or small, its motion slow or quick, makes no difference in the principle of it." (Lipscomb's Walker, *supra,* (Vol. III), at 258, citing *Brooks v. Jenkins* (1944) [27]).

Mr. Gabrielli argued that, since the lenses' prescriptions are a part of the decription of the invention, it would have been possible to rely on a specification of the combination program as a substitute for the prescriptions, so as to constitute part of the Specification of the invention. Since we have ruled that the prescriptions are not part of the invention, their substitute - namely, the program - is also not a part of the invention. The combination program is a tool used by the skilled person to build the product embodied in the invention. The Respondents' expert agreed, under cross-examination, with the definition of the program as "tools of the trade" (pp. 2157-2158). On the contrary, the inventor did not seek any legal protection for a component comprising or related to a program as aforesaid (and this is why no question arises here whether

computer programs are patentable). The parties also agreed that the combination program was not specially written for performing the patented invention in particular, but was intended for various applications in the combined field of conventional and holographic optics.

58. Accordingly, the question which we must consider is whether the inventor is under a duty to specify in the Patent the tools which are required to build the patented invention; is the manufacture of the product included in "the manner of performing the invention", as provided by Section 12 of the Law? This question does not usually arise, because in most cases the tools are used by the skilled persons and are part of the general knowledge in the relevant field. As an American Court said:

> "... there would seem to be no cogent reason to require disclosure of the menial tools known to all who practice this art." (*In Re Sherwood,* (1980) [28], at 544).

However, the above question may be important if the tools required to build the invention are not part of the prior art and are in the possession of the inventor. On the one hand, the inclusion in the Specification of tools and methods which are not part of the invention may impose an excessively heavy burden on the inventor, complicating the patent document and blurring the distinction between the protected field and other fields. As Blanco White said, *supra,* at 138:

> "There would seem to be no obligation to include information not strictly relating to 'the invention,' however necessary to anyone needing to work the invention."

On the other hand, without details of the tools as aforesaid, the skilled persons may not be able to build the protected product. They would be able to understand the invention and its operating principles, but they would not be able to build it. Blanco White adds and comments in this regard that -

> "It is not entirely clear, whether or to what extent there is an obligation to give directions as to techniques of manufacture where the invention claimed is only the finished article." (*ibid*.)

59. As for the present case, we may be satisfied with the preceding statements and leave the resolution of this question to another opportunity, because I hold that the Respondents failed to prove that the combination program in question was not part of the professional knowhow, or at least that it was not possible to write such a program with reasonable effort. I will clarify this forthwith.

60. The invention in the present case combines professional knowhow from several fields of advanced science. As the Respondents' expert stated in his opinion:

> "Holographic head-up displays combine several technologies. For example, the field of holography has evolved as a technical specialty and is applicable to the construction and use of the holographic

> combiner. The field of lens optics has also evolved as a technical specialty and is particularly related to the design of the relay lens system. The field of optics has become highly reliant upon computer technology to provide optical designs through computer ray tracing design techniques. In view of the complexity of these HUDs, high levels of skill are demanded of researchers and designers in this art."

This means that the question of sufficiency of the Description will be tested through the eyes of the professionals in the above fields, who have the aforesaid higher education and scientific experience in the design of combination systems. The issues concerning the combination software should be tested against the knowhow of these persons, who have professional knowhow concerning the design and use of "ray tracing" programs. It should be remembered that this professional field is characterized by intensive research and investment and that at least some of the organizations active in the industry are large companies with special research and development departments.

As stated earlier, on the date of issue of the Patent, two combination programs were in existence. The parties referred to one of them, the one at E.R.I.M. As is evident from the testimony, this Institute was prepared to make the aforementioned program available to optical design projects under contract. The operation of the software took place at and by the Institute. Mr. Gabrielli argued that in view of this arrangement, the combination software should not be considered part of the general knowledge of the professionals. On the other hand, Dr. Goldenberg argued that the arrangement proves that the program was available, as there is nothing wrong if payment has to be made in order to use it,

and that it was not proven that in order to fulfil the requirement of sufficiency, the physical use of the program cannot be made at the Institute which possesses it.

This question too, as to which much may be said on each side, I prefer to leave unanswered. On the date of issue of the Patent, the professionals had computer programs for the design of conventional optical elements and computer programs for the design of holographic elements. The Respondents' expert noted in his opinion that these programs were not available, or that they were available on a commercial basis only, but under cross examination he retracted his statement and admitted that in the early 1970s, programs of both types were already available to the professionals, some of them even free of charge. Mr. Gabrielli argued that the writing of a combination program from two ordinary programs constituted a substantive inovation, an inventive step in its own right, and it was therefore not part of the professional knowhow. However, no support was submitted for this. It was contended that the Appellant's expert said that it took him years before he was able to offer his clients a combination program, but we have found no reference to any such statement. The opposite conclusion appears from Mr. Grey's opinion (para. 39). The Appellant submitted a proposal by Mr. Grey to convert an ordinary program to a combination program in consideration of payment of $6,000, a negligible amount in terms of the Patent in question. However, this evidence is immaterial, because the proposal is dated 1978, some three years after the date of issue of the Patent, but it still does not show that on that date it was not possible to write a combination program with reasonable efforts.

In any event, the Respondents were required to prove their contention of insufficiency, but they failed to satisfy this burden. Incidentally, I also find it difficult to

reconcile the - for all practical purposes - copying of the invention with the contention of insufficiency of Description; it is equally difficult to contend insufficiency after the same party sought to prove that the patented invention was known and obvious. The contentions contradict one another.

61. Accordingly, this contention, as the two preceding contentions, is rejected. The conclusion is therefore that the Respondents failed to prove that the present Patent is invalid.

We will now discuss the last contention, i.e. the matter of the license.

The Matter of the License

62. The third group of contentions raised by the Respondents concerns a license granted by the Appellant to the United States government. According to the Respondents, even if it is held that the Patent is valid and that it was infringed, the aforesaid license protects the utilization of the HUD in the manner and under the circumstances of the present proceedings. The license was granted within the framework of a contract entered into by the Appellant and the United States Air Force (hereinafter - "the invention contract"). This form of contract is common in the United States and it provides principally that in consideration of funding received by the private party from the government or from one or another public agency, the first party undertakes to grant the latter party rights in the invention which it will attain in the course of or within the framework of the invention contract ("subject invention"). In general, the rights which are granted the government are rights to utilize the invention,

in the form of a license, while ownership of the invention remains with the inventor. In the present invention contract, such a license was arranged by embodying in the contractual arrangement a clause contained in the Armed Services Procurement Regulations (hereinafter - "A.S.P.R.").

The invention contract referred to the development of the holographic helmet, and there was no mention in it, whatsoever, of the HUD. However, the Respondents contended that the helmet which was invented within the framework of the contract and the HUD are one and the same invention, or at least the HUD constitutes a "subject invention" to the license, or alternatively, it should be deemed an obvious extension of the helmet. The Respondents further contended that since the purchase of the HUD by Respondent 1 was made with funding provided by the United States government, the license covers this purchase, as well as the utilization of the HUD by the State of Israel.

The Appellant responded to this contention with the following three arguments:

(a) The HUD is a separate invention from the helment and is not a "subject invention," or an obvious extension of the helmet, so it is not subject to the license at all.

(b) The license was granted to the United States government and to it alone while the funding of the invention does not bring the Respondents' acts under the protection of the license.

(c) The license was not registered as a patent in Israel, and according to the provision of Section 83 of the Patents Law, it is not valid in Israel.

In order to clarify the American law on the numerous questions which arose before the lower court, each party recruited an expert, who submitted written opinions on which they were examined before the Court. An additional expert appeared on behalf of the Respondents to prove the matter of the funding.

63. The District Court examined the first question above and preferred the statements of the witness for the Appellant, Mr. Denniston, over the explanations of the Respondents' expert, Mr. Anthony, namely - that the HUD cannot be considered a "subject invention." The Court added that within the contractual framework associated with the license, the HUD cannot be considered one invention together with the helmet or an obvious extension of it.

As for the question of the applicability of the license to the Respondents' acts, the Court expressed the opinion that -

> "...even if I would have concluded that the United States government has a license to utilize the HUD, it cannot be extended to the Defendants' acts. The license allows the United States government to utilize the subject invention or to allow another to utilize it for government purposes. Utilization by the Defendant cannot be included within this power, while the funding of the project is also not included in the methods of acquisition in the A.S.P.R. clause."

In view of the above conclusions, the lower court preferred not to resolve the question of the effect of Section 87 of the Patents Law, stating that the wording of the Section is not entirely unambiguous.

64. I, too, hold that the Respondents' contentions should be rejected. I have arrived at this conclusion on the basis of the second question above: I am persuaded that the Respondents failed to show how the funding of the transaction links their acts to the protection of the license granted to the United States government. Accordingly, I see no reason to resolve the complex issues raised by the first question above, i.e. whether the license is applicable to the invention of the HUD. The lower court made rulings on some of these issues, which concern principles of interpretation in American law, the status of various documents for the purpose of interpreting the invention contract, and the tests used to define a "subject invention"; but since it is not necessary to enter into these issues, they may be left unresolved.

In my view, as was the view of the lower court, Section 87 of the Patents Law is not unambiguous and it is preferable to leave it to be clarified and resolved in the future.

65. Before discussing the subject of the license, I wish to repeat the comment made by the lower court that -

> "The contention concerning the license is a defense argument and it is clear that the burden of proof as to the foreign law - the law of the

United States - (which for purposes of this matter should be deemed a fact requiring proof just as any other fact) rests on the Defendant."

As for proof of the foreign law and the discretion granted to the Court to rely on experts concerning the foreign law, see, for example: C.A. 118/51 [9], at p. 527; C.A. 376/68 [10], at p. 608; Prof. M. Shava, "The Nature and Method of Proving Foreign Law in Anglo-American Law and Israeli Law", 3 Tel Aviv U.L. Rev. (1973) 725, 735-736, 745.

66. The rights to utilize the invention were defined in that clause of the license which was incorporated in the invention contract (A.S.P.R. Sec. 7-302.23(b)(1)), as follows:

"(b) Rights Granted to the Government.

(1) The Contractor agrees to and does hereby grant to the Government an irrevocable, nonexclusive, and royalty-free license to practice and have practiced each Subject Invention (made by the Contractor) throughout the world for Government purposes, and including the practice of each such Subject Invention (i) in the manufacture, use, and disposition of any article or material, (ii) in the use of any method, or (iii) in the performance of any service, acquired by or for the Government or with funds derived through the Military Assistance Program of the Government or funds otherwise derived through the Government."

The Appellant's expert stated in his opinion that the wording of the clause, as well as its legislative history - primarily files of reports of A.S.P.R. tribunals (A.S.P.R. Cases) - show that it comprises four elements, all of whose conditions must be satisfied, for the license to apply to a particular act. The elements are:

(a) The license is granted to the United States government - and to it only - and it has the right to utilize the invention itself or to allow others to utilize it.

(b) The government's right as aforesaid applies throughout the world, but it must be for "government purposes."

(c) There are several ways to utilize the invention, including utilization by production and utilization of the product or any material, or utilization of any system or performance of a service.

(d) There are several ways to acquire the aforesaid products or services, including acquisition by or on behalf the United States government, acquisition with funds that derive from a military aid program, or with funds that derive from the United States government in some other way.

There is no dispute that the Respondents do not have a license from the Appellant or a sublicense from the United States government to utilize a "subject invention," as stated in the clause. It is also evident that the parties do

not dispute that if the Respondents had had any such sublicense or if the United States government had acquired the HUD from Respondent 2 and given it to the State of Israel, on account of military aid funds, then the license would be applicable (assuming that it is a "subject invention", of course).

However, according to the Respondents, the license clause should be interpreted differently. During the proceedings in the lower court, their witness set forth the clause's structure as if it comprises an original license (the first part) and a second subsequent license (the second part), which was added in the course of modification of the clause in order to widen its application. During the hearing of the Appeal, Counsel for the Respondents did not repeat this contention, and sought to rely on the literal interpretation of the clause, arguing that in the second part of the clause, three connections were included in the license, whether included in the definition of "for government purposes" or not. Mr. Gabrielli sought to show that by the term "and including", the American secondary legislator sought to widen the application of the license. It is therefore sufficient that the HUD was acquired with funds originating from the United States government, as stated in the last sentence of the clause, to benefit from the protection of the license.

…

I find this interpretation difficult to accept, and in any event it was not proved by the testimony of the Appellant's witness. On the contrary, in the opinion of Mr. Anthony, which was submitted prior to that of Mr. Denniston, the clause appears in a schematic structure of cumulative conditions for its application (p. 18 of the opinion). Mr. Anthony raised the hypothesis of an original license and an additional license at the

hearing, only after Mr. Denniston's opinion was submitted, and this hypothesis was abandoned in the Appeal, as stated earlier. Furthermore, the Respondents' expert admitted under cross examination that the mere fact that the funding originated from the United States government does not bring it within the ambit of the license. There must be a specific intent on the part of the government:

> "I don't believe there is any case law on this, but I think there needs to be some direction of the money from the United States government to a purpose. There is no case law that I know of, but it needs to be something like a foreign military sale or any funding where there is some earmarking of the money, if you will. The mere fact that the money somehow at one point came from the United States, I would suspect would not give... a licence."

In any event, the Respondents failed to prove their contention concerning the meaning attributed to the term "and including" in American law, particularly in the relevant and unique area in question.

67. Accordingly, the Respondents should have shown that their acts come within the ambit of the conditions of the first part of the clause, and in particular that those acts were within the ambit of allowing the utilization of the invention by the United States government, and that it was for government purposes only. These two conditions were not fulfilled. The term "government purposes" was defined in the A.S.P.R. Regulations as follows:

> "Government purpose means the right of the Government of the United States (including any agency thereof, state or domestic municipal government) to practice and have practiced (make or have made, use or have used, sell or have sold) an(y) Subject Invention throughout the world by or on behalf of the Government of the United States." (A.S.P.R. Sec. 9.107-5(B)(A)(2)).

It is clear from the above definition that a purchase by a foreign government is not "on behalf" of the United States government, even if the funds originate from the United States government. The Respondents did not prove that the purchase funds were designated by the government for the acquisition of a "subject invention" specifically, nor was any evidence brought to show that the government knew of any such acquisition. The Respondents did not show that the degree of involvement of the United States government in their acts justifies their inclusion in the aforesaid definition. As the Appellant's expert said:

> "I believe that the definition of 'Government purpose' and the phrase 'on behalf of' contemplate a much greater degree of United States involvement in and direct benefit from the activity resulting from the practice of a Subject Invention than is indicated here. For example, practicing a Subject Invention would be on behalf of the United States if the Government provided funds for Israel to construct facilities or equipment to be used by or as directed by the Government. Examples of such facilities might include a listening post for gathering electronic intelligence or a radio station for

broadcasting the Voice of America." (P. 58 of his opinion, and see the judgments analyzed there in illustration).

Fulfillment of the United States' government's right to "have practiced" was also not proved.

68. Beyond all that has been said, it appears that in terms of the considerations guiding the courts in the United States with respect to invention contracts such as the present contract, we must conclude that the Respondents' acts are not within the ambit of the license. As Mr. Gabrielli explained, the concept underlying the A.S.P.R. Regulation is that the American taxpayer should not have to bear a double burden: to fund the development of the invention, and to pay royalties or other compensation to the inventor. This idea was expressed by an American court (in reference to a comparable arrangement), as follows:

"Inventions made under a government contract are the product of expenditures from the public treasury in the course of a governmental function: the public, having in a sense ordered and paid for the invention through its representatives, should not again be taxed for its use, nor excluded from its use, nor permitted to use it upon restrictive conditions advantageous to no one but the patent owner." *(Mine Safety Appliances Co. v. United States,* (1966) [29], at 392).

Mr. Gabrielli sought to compare this test to the present case, arguing that obliging Respondent 2 to pay royalties to the Appellant would increase the purchase cost to the

State of Israel, and this increase would have to borne by the American taxpayer. I hold that this argument is unfounded. As stated earlier, the license was granted by the Appellant to the United States government, for its utilization and purposes, and we cannot consider every purchase with funds originating from the United States government to be protected by the license. The license was granted, but the ownership of the Patent remains with the Appellant, and ownership entails the freedom to use it, as well as the right to prevent competitors from infringing it. Respondent 1 was free to choose the Appellant's proposal rather than that of Respondent 2; no evidence was submitted that the United States government instructed Respondent 1 to turn to Respondent 2 alone, or that it conditioned the use of military aid funds upon the purchase from one manufacturer or another.

69. To summarize, the argument based on the license is rejected as well. For the purpose of this analysis we assumed that the form of funding as stipulated in the second part of the license was actually proved, but it goes without saying that this assumption does not entail any factual finding on the subject.

70. The conclusion that arises from all the foregoing is that the main Appeal should be allowed, and there is therefore no need to consider the issue of the costs, which forms the subject of the Counter-Appeal.

The Appeal is allowed, and we therefore order the Respondents to abstain from infringement of the Patent, either themselves or through others.

We further order the Respondents to submit to the District Court a report as requested in paragraphs 16(c) and (d) of the Statement of Claim, within 120 days from the reading of the judgment.

The proceeding is returned to the lower court to hear evidence and decide the matter of the compensation sought by the Appellant.

Respondent 2 shall bear the Appellant's costs in the amount of NIS 50,000 as of the date of this judgment.

We order that the judgment be published, with the omission of those passages which cannot be published for reasons of national security, concerning which Respondent 1 shall submit to this Court a written petition, with a copy to the litigants, within 30 days from today, to which the Appellant and Respondent 2 may respond in writing within 15 days from its submission. Until the decision on the petition, the judgment shall continue to be subject to the provisions of Sections 68 and 70(a) of the Courts Law (Consolidated Version) 5744-1984.

Barak J.: I concur.

Bach J.: I concur.

Decided as stated in the judgment of the President.

Given this day, July 2, 1990.