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(54) **INFRA-RED RADIATION EMISSION ARRANGEMENT.**

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Description

This invention relates to an infra-red radiation emission arrangement.

Infra-red radiation emitters are known which comprise a tungsten filament in an envelope of vitreous silica. Such emitters have a fast response, in that the radiation emitted can change from full power to negligible values within one second of the emitter being switched off. However, such emitters emit radiation primarily in the short wavelength of infra-red radiation, ie. in the range of from 0.8 to 2.5 microns or in the medium wavelength of infra-red radiation, from 1.2 to 4.0 microns.

It is also known to provide long wavelength infra-red radiation emitters, emitting radiation in the wavelength range from 2 to 10 microns, in which a substrate is maintained at a temperature which determines the wavelength of the emitted radiation. However, such emitters have a slow thermal response, of the order of 200 to 300 seconds.

It is known from EP-A-0134090 and GB-A-2160400 to provide an infra-red radiation emission arrangement comprising a primary source of short or medium wavelength infra-red radiation arranged to emit the radiation in a first direction, and a substrate of thermally insulating material having a surface spaced apart from the primary source and facing the first direction. This arrangement does not, however, provide for significant re-radiation of long wavelength infra-red radiation since the surface has a high reflectivity.

It is an object of the present invention to provide an improved infra-red radiation emission arrangement.

According to the present invention there is provided an infra-red radiation emission arrangement comprising:

a primary source of short or medium wavelength infra-red radiation arranged to emit said short or medium wavelength infra-red radiation in a first direction;

and a substrate of thermally insulating material having a surface spaced apart from said primary source and facing said first direction;

characterised by a coating of an infra-red radiation absorptive material provided on at least a part of said surface on which, in use, said short or medium wavelength infra-red radiation is incident, said coating being adapted to absorb said short or medium wavelength infra-red radiation whereby said coating is heated to re-radiate infra-red radiation at a longer wavelength in a second direction, substantially opposite said first direction; said infra-red absorptive material having a normal spectral emittance at infra-red wavelengths of at least 0.8.

In an arrangement provided in accordance with the present invention, radiation from said primary source is incident on, and absorbed by, said coating. As the substrate is thermally insulating, little heat is conducted away from said coating and so the coating is maintained above ambient temperature. The temperature achieved by the infra-red absorptive material will depend upon the intensity of the short or medium wavelength infra-red radiation from said primary source incident thereon, and on the absorptivity/reflectivity of said coating. The intensity of radiation incident on said coating is itself dependent upon the positioning and shaping of said coating relative to said primary source. Accordingly, said coating will be at a lower temperature, and so will emit radiation of a longer wavelength than, said primary source.

Advantageously, a part of said surface is reflective of radiation at infra-red wavelengths. The total radiation output of such an arrangement is a combination of the short or medium wavelength radiation from said primary source, reflected by said surface, and medium/long wavelength radiation emitted by said coating. In this way, the total radiation output of the arrangement can be further controlled.

Advantageously, said coating has a low thermal mass, responding rapidly in temperature to variations in the incident infra-red radiation. The thermal response of the arrangement is dependent upon the thermal response of said primary source, which can be very fast as indicated previously and the thermal mass of that part of the substrate which responds to the incident infra-red radiation. Accordingly, an arrangement according to this aspect of the present invention has a relatively fast thermal response and an emission spectrum in the long wavelength infra-red.

The arrangement of the invention has the advantages that it has a faster thermal response time when emitting in the long wavelength region of the infra-red spectrum than known emission arrangements, and also that it provides for controllable broadening of the useful wavelength limits of the total radiation output from the arrangement as compared with a conventional single hot body infra-red emitter.

Preferably said surface of the coating re-radiates at least 50%, and preferably at least 85% of the radiation energy incident on said coating from the primary source.

Advantageously said primary source includes an envelope, a part of said envelope through which radiation is transmitted away from said surface being coated with an infra-red radiation absorptive material which, in operation, is heated to re-radiate infra-red radiation at a longer wavelength.

Alternatively, the arrangement can include a secondary reflector to direct radiation from said primary source towards said surface.

Embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 shows a composite arrangement comprising three infra-red radiation emission arrangements provided in accordance with the present invention;

Figure 2 shows the spectral output of a tungsten quartz emitter for use with an arrangement according to the present invention;

Figures 3 and 4 show second and third embodiments of infra-red radiation emission arrangements provided in accordance with the present invention;

Figure 5 shows a substrate for use with a fourth embodiment of an infra-red radiation emission arrangement provided in accordance with the present invention;

Figures 6 and 7 show spectral outputs of arrangements provided in accordance with the present invention; and Figure 8 shows the reflectivity of a substrate for use with an arrangement according to the present invention.

Figure 1 shows three infra-red radiation emission arrangements 1, 2 and 3, each comprising a short wavelength infra-red radiation emitter 4, such as a tungsten quartz emitter. The spectral output of a known tungsten quartz emitter is shown in Figure 2. Each short wavelength infra-red radiation emitter 4 has an associated reflector 5 which is arranged to direct infra-red radiation from the emitter 4 towards a concave surface 6 of a high efficiency thermally insulating substrate 7. The substrate 7 may be made of a low thermal mass material, such as ceramic fibres or microporous thermally insulating material, which reflects radiation of infra-red wavelengths as well as being thermally insulating. The surface 6 has a coating 8 on which the radiation from the associated emitter 4 is incident. The coating 8 is of an infra-red radiation absorptive material, such as copper oxide, boron carbide or iron oxide. The coating 8 is heated by the incident radiation from the associated emitter 4 (indicated by arrow S) and emits infra-red radiation in the medium/long wavelength part of the infra-red radiation spectrum (as indicated by the arrow M/L). The coating is very thin, so that it has a low thermal mass and so responds quickly to variations in the infra-red radiation incident thereon.

The coating 8 may be made of any infra-red radiation absorptive material which has a high emissivity, preferably of at least 0.8. Table 1 shows a number of high emissivity materials and indicates the conditions at which this high emissivity was measured, namely the wavelength range of radiation emitted and the temperature of the material at which this emission took place.

TABLE 1

MATERIAL	CONDITIONS FOR NORMAL SPECTRAL EMITTANCE E > 0.8 WAVELENGTH (μm)	TEMP (K)	COMMENTS
Carbon (graphite)	1 to 6	1000 to 1400	In non-oxidising condition
Cr_2O_3	1 to 10	900 to 1000	
NiO	1 to 10	1273	
TiB_2	1 to 15	1273	
ZrB_2	1 to 15	873 to 1423	
SiC	0.8 to 10	873 to 1375	

MATERIAL	CONDITIONS FOR NORMAL SPECTRAL EMITTANCE E > 0.8 WAVELENGTH (μm)	TEMP (K)	COMMENTS
AlN	1 to 1.2; 3 to 13; E > 0.7 for 1.2 to 3	1023	
Si_3N_4	1 to 1.2; 1.8 to 15; E > 0.77 for 1.2 to 1.8	1023	
B_6Si	E > 0.95 for 1 to 6.8 E > 0.8 for 1 to 15	1023	
B_4Si	E > 0.78 for 1 to 15	1023	
Cr_3Si	2.1 to 15	1023	
$MoSi_2$	1 to 8	1273	
$TaSi_2$	1 to 15	1273	
$Be_{12}Ta$, $Be_{17}Ta_2$	1 to 7	1023 to 122	
NiAl	0.9 to 2	298	

MATERIAL	CONDITIONS FOR NORMAL SPECTRAL EMITTANCE E > 0.8 WAVELENGTH (μm)	TEMP (K)	COMMENTS
TaAl	1 to 6	1273	
TiAl	1 to 15	1023	
$TiCr_2$	1 to 15	1023	
NiAl/ Al_2O_3	1 to 15	1023	78 to 88 wt % NiAl
Al_2O_3/ TiAl	1 to 15	1023	88 wt % TiAl highest
Cr_2O_3/ $TiCr_2$	1 to 10	1273	1 wt % Cr_2O_3
Cr_2O_3/ $TiCr_2/TiO_2$	1 to 15	1023	10 wt % Cr_2O_3; 5 wt % TiO_2
NiO/NiAl	1 to 5	1273	28 wt % NiAl
NiO/NiAl/ Al_2O_3	1 to 5	1273	62 wt % NiAl /15 wt % Al_2O_3
TiB_2/Ti	1 to 15	1273	41 wt % Ti
TiB_2/ H_3BO_3	1 to 1.4 2.1 to 15	1023	1 wt % H_3BO_3

MATERIAL	CONDITIONS FOR NORMAL SPECTRAL EMITTANCE E > 0.8		COMMENTS
	WAVELENGTH (μm)	TEMP (K)	
$MoSi_2$/ MoO_3	1 to 15	1273	10 wt % MoO_3
$MoSi_2$/ SiO_2	1 to 15	1273	4 to 46 wt % SiO_2
TiB_2/ TiO_2	1 to 15	2073/1273	1 to 10 wt % TiO_2
$TiSi_2$/ Ti_5Si_3	1 to 15 (some 1 to 7)	1023	various compositions

Figure 3 shows a second embodiment of a radiation emission arrangement according to the present invention. In view of the similarity between this embodiment and the embodiment of Figure 1, like parts are designated by like references. In the embodiment of Figure 3, the surface 6 is provided as a planar surface. Surfaces having other geometries may also be used.

Figure 4 shows a third embodiment of an infra-red radiation emission arrangement prepared in accordance with the present invention. Like parts to those of Figures 1 and 3 are designated by like references. In this embodiment, the primary source 4 is shown in greater detail as a tungsten filament 10 in an envelope 12 of vitreous silica. Part of the envelope 12 through which radiation from the filament 10 is transmitted, away from the substrate 7, is coated with an infra-red radiation absorptive material having a high emissivity. Suitable materials are those disclosed in table 1 previously. As with the coating 8 on the substrate 7, the coating 14 on the envelope 12 is heated by the incident radiation from the tungsten filament 10 and emits infra-red radiation in the medium/long wavelength part of the infra-red radiation spectrum. An advantage of this embodiment over the embodiments of Figures 1 and 3 is that the effect of shielding of radiation from the coating 8 by the secondary reflector 5 of Figure 1 and 3 on the total radiation output of the embodiment is reduced. In Figure 4, the arrow s indicates short wavelength radiation from the primary source and the arrow M/L indicate longer wavelength radiation.

As discussed above, the total radiation output of each infra-red radiation emission arrangement 1, 2 or 3 can be set by appropriate selection of the mass, ie. the thickness, and the material of the coating 8, and of the position of the emitter 4 and its reflector 5 relative to the coated surface 6 of the substrate 7, such selection determining the temperature of the coating 8 during operation.

Figure 5 shows a substrate 7 for use with a fourth embodiment of an infra-red radiation emission arrangement provided in accordance with the present invention. Like parts to those of Figures 1 and 3 are designated by like references. In this embodiment, the surface 6 is partially not covered by the coating 8. Accordingly, infra-red radiation incident on the uncoated parts 9 from the associated emitter 4 will be directly reflected therefrom. The total radiation output of this arrangement is a combination of radiation at medium/long wavelengths emitted from the coating 8 and infra-red radiation of short/medium wavelengths reflected from the uncoated part 9.

In the embodiments described previously, the coating 8 has a sufficient quantity of infra-red absorptive material per unit surface area of the part of the substrate 7 that substantially all of the incident infra-red radiation is absorbed and re-radiated at longer wavelengths. Alternatively, the coating 8 may include an insufficient quantity of infra-red radiation absorptive material to absorb all of the incident infra-red radiation. It is envisaged that this may be because the quantity of material is insufficient to coat the entire surface of the substrate 7 so that incident radiation is reflected from the uncoated parts. In this latter case, the infra-red radiation that is not absorbed by the coating 8 is transmitted to the substrate 7 and reflected therefrom. Accordingly, as with the embodiment of Figure 5, the total radiation output of such an arrangement is a combination of radiation at medium/long wavelength emitted from the coating 8 and infra-red radiation of short/medium wavelengths reflected from the substrate 7.

Figures 6 and 7 show spectral output for infra-red emission arrangements provided in accordance with the present invention. In the examples, the substrate 7 was made of an alumino-silicate ceramic fibre board (for example "Kaowool 1600" manufactured by Morgan Ceramic Fibres Limited) of thickness 5 mm to 7 mm with a backing of microporous thermal insulation board (for example, "Microtherm" manufactured by Micropore Insulation Limited) of thickness 25 mm. Alternatively, a single board of ceramic fibre or Microtherm of thickness 25 mm to 30 mm may be used. The quoted thermal conductivities of the substrate material are 0.079 W/mK for Kaowool and 0.025 W/mK for Microtherm. The reflectivity of these two substrate materials at short wavelengths of infra-red radiation is high - a graph showing the reflectivity of Microtherm is provided as Figure 8.

In the examples, the material used for the absorptive coating is silicon carbide although successful emission arrangements have also been made using coatings of copper oxide, boron silicide and molybdenum disilicide. As indicated previously, silicon carbide is known to have an emissivity of at least 0.8. Its absorptivity is dependent on the quantity of material provided per unit surface area of substrate. Above a certain value of the coating thickness, the absorptivity equals the emissivity and the coating is opaque to the incident radiation. For the particular silicon carbide used, this critical value was 150 grams per square metre.

In each example, the substrate 7 and coating 8 were planar and the substate and primary sources were arranged horizontally.

Figure 6 shows the effect of the amount of material in the coating on the spectral radiation output from the substrate. The details of the examples are as follows:

Example A - uncoated Kaowool;

Example B - Kaowool with a coating of silicon carbide of coat weight 50 grams per square metre;

Example C - Kaowool with a coating of silicon carbide of coat weight 150 grams per square metre.

It can be seen that the spectral radiation output for example C is primarily at wavelengths greater than 2 microns. The spectral radiation output for example B, however, includes a significant component at wavelengths less than 2 microns which is contributed by reflection from the Kaowool.

Figure 7 shows the effect of leaving part of the substrate surface uncoated, the remainder being coated with silicon carbide of coat weight 150 grams per square metre. The details are as follows:

Example A - uncoated Kaowool;

Example D - equal strips of coated and uncoated Kaowool;

Example E - surface area of coating is twice that of the uncoated Kaowool;

Example F - Kaowool completely coated;

It can be seen that as the area of uncoated Kaowool is increased, the proportion of infra-red radiation at wavelengths less than 2 microns increases.

As shown in Figures 6 and 7, the spectral output of example A is primarily at the short wavelength end of the infra-red radiation spectrum and although this example, which is not an emission arrangement in accordance with the present invention, has the best thermal response, this is primarily due to the fast thermal response of the primary source. The other examples B, C, D and E have a substantially faster thermal response than the commercial long wavelength radiation emitters such as Pearlco 500 watt and Vulcan 400 watt.

Arrangements in accordance with the invention can be used as heat/curing sources in commercial process ovens, or as domestic heating sources.

Modifications to the embodiments described within the scope of the present invention will be apparent to those skilled in the art.

Claims

1. An infra-red radiation emission arrangement comprising:

a primary source (4) of short or medium wavelength infra-red radiation arranged to emit said short or medium wavelength infra-red radiation in a first direction;

and a substrate (7) of thermally insulating material having a surface (6) spaced apart from said primary source (4) and facing said first direction;

characterised by a coating (8) of an infra-red radiation absorptive material provided on at least a part of said surface (6) on which, in use, said short or medium wavelength infra-red radiation is incident, said coating (8) being adapted to absorb said short or medium wavelength infra-red radiation whereby said coating (8) is heated to re-radiate infra-red radiation at a longer wavelength in a second direction, substantially opposite said first direction; said infra-red absorptive material having a normal spectral emittance at infra-red wavelengths of at least 0.8.

2. An arrangement according to Claim 1 characterised in that said coating (8) re-radiates at least 50% of the incident infra-red radiation energy.

3. An arrangement according to Claim 2 characterised in that coating (8) re-radiates at least 85% of the incident infra-red radiation energy.

4. An arrangement according to any preceding claim characterised in that said coating (8) covers only a part of said surface (6) and a part of said surface (6) not covered by said coating (8) is reflective of radiation at infra-red wavelengths.

5. An arrangement according to any preceding claim characterised in that the quantity of said infra-red radiation absorptive material provided per unit surface area of said at least part of said surface (6) is sufficient to absorb substantially all of said short and medium wavelength infra-red radiation.

6. An arrangement according to any preceding claim characterised in that said surface (6) is reflective of radiation at infra-red wavelengths and the quantity of said infra-red radiation absorptive material provided per unit surface area of said at least part of said surface (6) is insufficient to absorb substantially all of said short and medium wavelength infra-red radiation whereby a part of said short and medium wavelength infra-red radiation is reflected from said surface (6).

7. An arrangement according to any preceding claim characterised in that said infra-red radiation absorptive material is selected from the group consisting of copper oxide, boron carbide and iron oxide.

8. An arrangement according to any preceding claim characterised in that said infra-red radiation absorptive material is silicon carbide.

9. An arrangement according to any preceding claim characterised in that said thermally insulating material comprises ceramic fibre.

10. An arrangement according to any one of Claims 1 to 8 characterisd in that said thermally insulating material is microporous thermally insulating material.

11. An arrangement according to any preceding claim characterised in that said primary source (4) includes an envelope (12).

12. An arrangement according to Claim 11 characterised in that said primary source (4) includes a tungsten filament (10) in said envelope (12).

13. An arrangement according to Claims 11 or 12 characterised in that said primary source (4) is arranged to emit said short or medium wavelength infra-red radiation also in said second direction, and a part of said envelope (12) through which radiation is transmitted in said second direction is provided with a primary source coating (4) formed of an infra-red radiation absorptive material which absorbs said short or medium wavelength infra-red radiation emitted by said primary source (4) in said second direction, whereby said primary source coating (14) is heated to re-radiate infra-red radiation at a longer wavelength.

14. An arrangement according to any one of Claims 1 to 12 characterised by a secondary reflector (5) to direct radiation from said primary source (4) towards said surface (6) in said first direction.

Patentansprüche

1. Infrarot-Strahlungsemissionsanordnung, umfassend: eine Primärquelle (4) kurz- oder mittelwelliger Infrarot-Strahlung, welche zur Emission der kurz- oder mittelwelligen Infrarot-Strahlung in einer ersten Richtung ausgelegt ist, sowie ein Substrat (7) aus thermisch isolierendem Material mit einer von der Primärquelle (4) im Abstand vorgesehenen und in die erste Richtung weisenden Oberfläche (6), **gekennzeichnet durch** eine auf zumindest einem Teil der Oberfläche (6), auf den die kurz- oder mittelwellige Infrarot-Strahlung im Gebrauch einfällt, vorgesehene Schicht (8) eines Infrarot-Strahlung absor-

bierenden Materials, wobei die Schicht (8) ausgeführt ist, die kurz- oder mittelwellige Infrarot-Strahlung zu absorbieren, wodurch die Schicht (8) zur Abstrahlung längerwelliger Infrarot-Strahlung in einer zweiten, der ersten Richtung im wesentlichen entgegengesetzten Richtung erwärmt wird, wobei das infrarotabsorbierende Material bei Infrarot-Wellenlängen eine normale spektrale Emittanz von wenigstens 0,8 aufweist.

2. Anordnung nach Anspruch 1,
dadurch gekennzeichnet,
daß die Schicht (8) wenigstens 50% der einfallenden Infrarot-Strahlungsenergie wieder abstrahlt.

3. Anordnung nach Anspruch 2,
dadurch gekennzeichnet,
daß die Schicht (8) wenigstens 85% der einfallenden Infrarot-Strahlungsenergie wieder abstrahlt.

4. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß die Schicht (8) lediglich einen Teil der Oberfläche (6) bedeckt und ein von der Schicht (8) nicht bedeckter Teil der Oberfläche (6) für Strahlung bei Infrarot-Wellenlängen reflektierend ist.

5. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß die pro Einheitsfläche des zumindest einen Teils der Oberfläche (6) vorgesehene Menge des Infrarot-Strahlung absorbierenden Materials ausreichend ist, im wesentlichen die gesamte kurz- und mittelwellige Infrarot-Strahlung zu absorbieren.

6. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß die Oberfläche (6) für Strahlung bei Infrarot-Wellenlängen reflektierend ist und die pro Einheitsfläche des zumindest einen Teils der Oberfläche (6) vorgesehene Menge des Infrarot-Strahlung absorbierenden Materials nicht ausreichend ist, im wesentlichen die gesamte kurz- und mittelwellige Infrarot-Strahlung zu absorbieren, wodurch ein Teil der kurz- und mittelwelligen Infrarot-Strahlung von der Oberfläche (6) reflektiert wird.

7. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß das Infrarot-Strahlung absorbierende Material aus der aus Kupferoxid, Borcarbid und Eisenoxid bestehenden Gruppe ausgewählt ist.

8. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß das Infrarot-Strahlung absorbierende Material Siliziumcarbid ist.

9. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß das thermisch isolierende Material Keramikfaser umfaßt.

10. Anordnung nach einem der Ansprüche 1 bis 8,
dadurch gekennzeichnet,
daß das thermisch isolierende Material mikroporöses thermisch isolierendes Material ist.

11. Anordnung nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
daß die Primärquelle (4) eine Umhüllung (12) umfaßt.

12. Anordnung nach Anspruch 11,
dadurch gekennzeichnet,
daß die Primärquelle (4) in der Umhüllung (12) einen Wolframfaden (10) umfaßt.

13. Anordnung nach Anspruch 11 oder 12,
dadurch gekennzeichnet,

daß die Primärquelle (4) zur Emission der kurz- oder mittelwelligen Infrarot-Strahlung auch in der zweiten Richtung ausgelegt ist und ein Teil der Umhüllung (12), durch den Strahlung in der zweiten Richtung durchgelassen wird, mit einer Primärquellenschicht (4) versehen ist, welche aus einem Infrarot-Strahlung absorbierenden Material gebildet ist, das die von der Primärquelle (4) in der zweiten Richtung emittierte kurz- oder mittelwellige Infrarot-Strahlung absorbiert, wodurch die Primärquellenschicht (14) zur Abstrahlung längerwelliger Infrarot-Strahlung erwärmt wird.

14. Anordnung nach einem der Ansprüche 1 bis 12,
gekennzeichnet durch einen Sekundärreflektor (5), um Strahlung der Primärquelle (4) in der ersten Richtung auf die Oberfläche (6) zu richten.

Revendications

1. Dispositif d'émission de rayonnement infrarouge, comprenant:

une source principale (4) d'un rayonnement infrarouge à longueur d'onde courte ou moyenne, conçue pour émettre ledit rayonnement infrarouge, à longueur d'onde courte ou moyenne, dans une première direction;

et un substrat (7) en un matériau thermiquement isolant, qui présente une surface (6) espacée de ladite source principale (4) et faisant face à ladite première direction;

caractérisé par un revêtement (8) en un matériau absorbant les rayonnements infrarouges, présent sur au moins une partie de ladite surface (6) sur laquelle tombe, en service, ledit rayonnement infrarouge à longueur d'onde courte ou moyenne, ledit revêtement (8) étant adapté pour absorber ledit rayonnement infrarouge à longueur d'onde courte ou moyenne, grâce à quoi ledit revêtement (8) est chauffé pour retransmettre le rayonnement infrarouge à une longueur d'onde plus grande dans une deuxième direction, sensiblement opposée à ladite première direction; ledit matériau absorbant l'infrarouge ayant, aux longueurs d'onde du domaine infrarouge, un pouvoir émissif spectral normal d'au moins 0,8.

2. Dispositif selon la revendication 1, caractérisé en ce que ledit revêtement (8) retransmet au moins 50% de l'énergie du rayonnement infrarouge incident.

3. Dispositif selon la revendication 2, caractérisé en ce que le revêtement (8) retransmet au moins 85% de l'énergie du rayonnement infrarouge incident.

4. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit revêtement (8) ne couvre qu'une partie de ladite surface (6), et une partie de ladite surface (6), non couverte par ledit revêtement (8), est réfléchissante à l'égard de rayonnements ayant des longueurs d'onde du domaine infrarouge.

5. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que la quantité dudit matériau absorbant les rayonnements infrarouges, prévue par unité de surface de ladite partie au moins de ladite surface (6), est suffisante pour absorber sensiblement la totalité dudit rayonnement infrarouge à longueur d'onde courte ou moyenne.

6. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ladite surface (6) est réfléchissante à l'égard de rayonnements ayant des longueurs d'onde du domaine infrarouge et la quantité dudit matériau absorbant les rayonnements infrarouges, prévue par unité de surface de ladite partie au moins de ladite surface (6), est insuffisante pour absorber sensiblement en totalité ledit rayonnement infrarouge à longueur d'onde courte et moyenne, une partie dudit rayonnement infrarouge à longueur d'onde courte et moyenne étant ainsi réfléchie par ladite surface (6).

7. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit matériau absorbant les rayonnements infrarouges est choisi dans le groupe comprenant l'oxyde de cuivre, le carbure de bore et l'oxyde de fer.

8. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit matériau absorbant les rayonnements infrarouges est du carbure de silicium.

9. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit matériau thermiquement isolant comprend de la fibre céramique.

10. Dispositif selon l'une quelconque des revendications 1 à 8, caractérisé en ce que ledit matériau thermiquement isolant est un matériau thermiquement isolant microporeux.

11. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ladite source principale (4) comprend une enveloppe (12).

12. Dispositif selon la revendication 11, caractérisé en ce que ladite source principale (4) comprend un filament de tungstène (10) dans ladite enveloppe (12).

13. Dispositif selon la revendication 11 ou 12, caractérisé en ce que ladite source principale (4) est conçue pour émettre ledit rayonnement infrarouge à longueur d'onde courte ou moyenne également dans ladite deuxième direction, et une partie de ladite enveloppe (12), à travers laquelle le rayonnement est transmis dans ladite deuxième direction, est pourvue d'un revêtement (14) de source principale, formé d'un matériau absorbant les rayonnements infrarouges, qui absorbe ledit rayonnement infrarouge à longueur d'onde courte ou moyenne émis par ladite source principale (4) dans ladite deuxième direction, ledit revêtement (14) de source principale étant ainsi chauffé pour retransmettre le rayonnement infrarouge à une longueur d'onde plus grande.

14. Dispositif selon l'une quelconque des revendications 1 à 12, caractérisé par un réflecteur secondaire (5) destiné à diriger le rayonnement provenant de ladite source principale (4) vers ladite surface (6), dans ladite première direction.

FIG. 1.

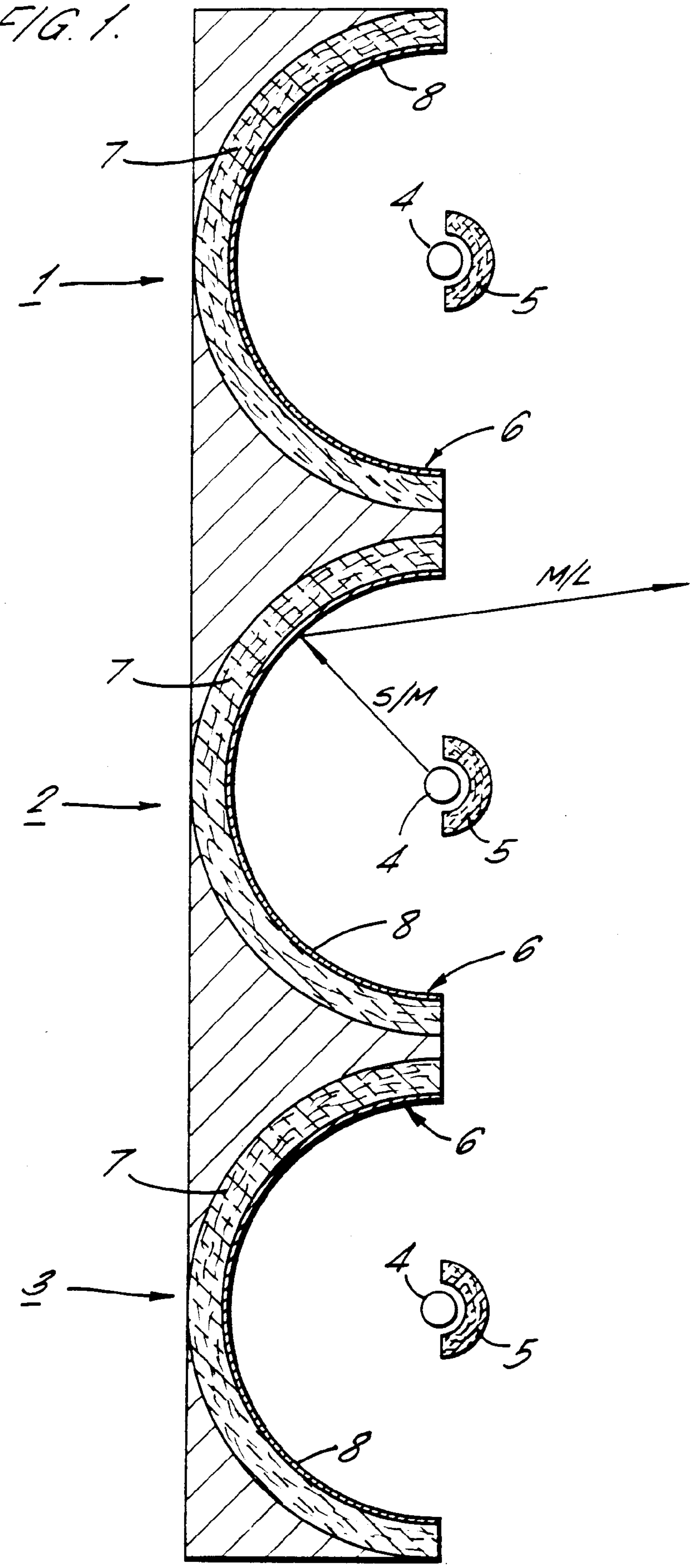


FIG. 2.

SPECTRAL EMISSION FROM A TUNGSTEN FILAMENT SHORT WAVE IR EMITTER. (FILAMENT TEMPERATURE 2400°K)

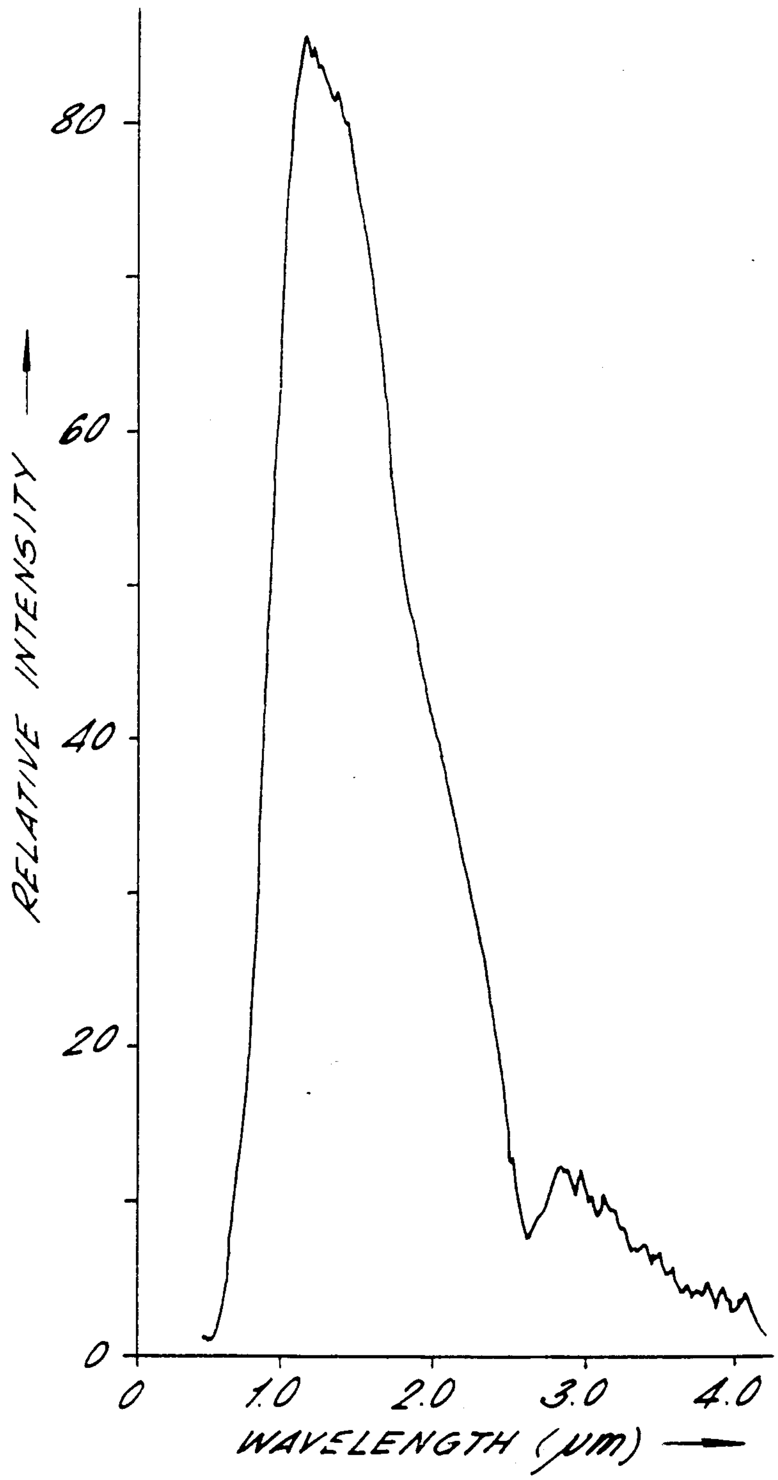


FIG. 3.

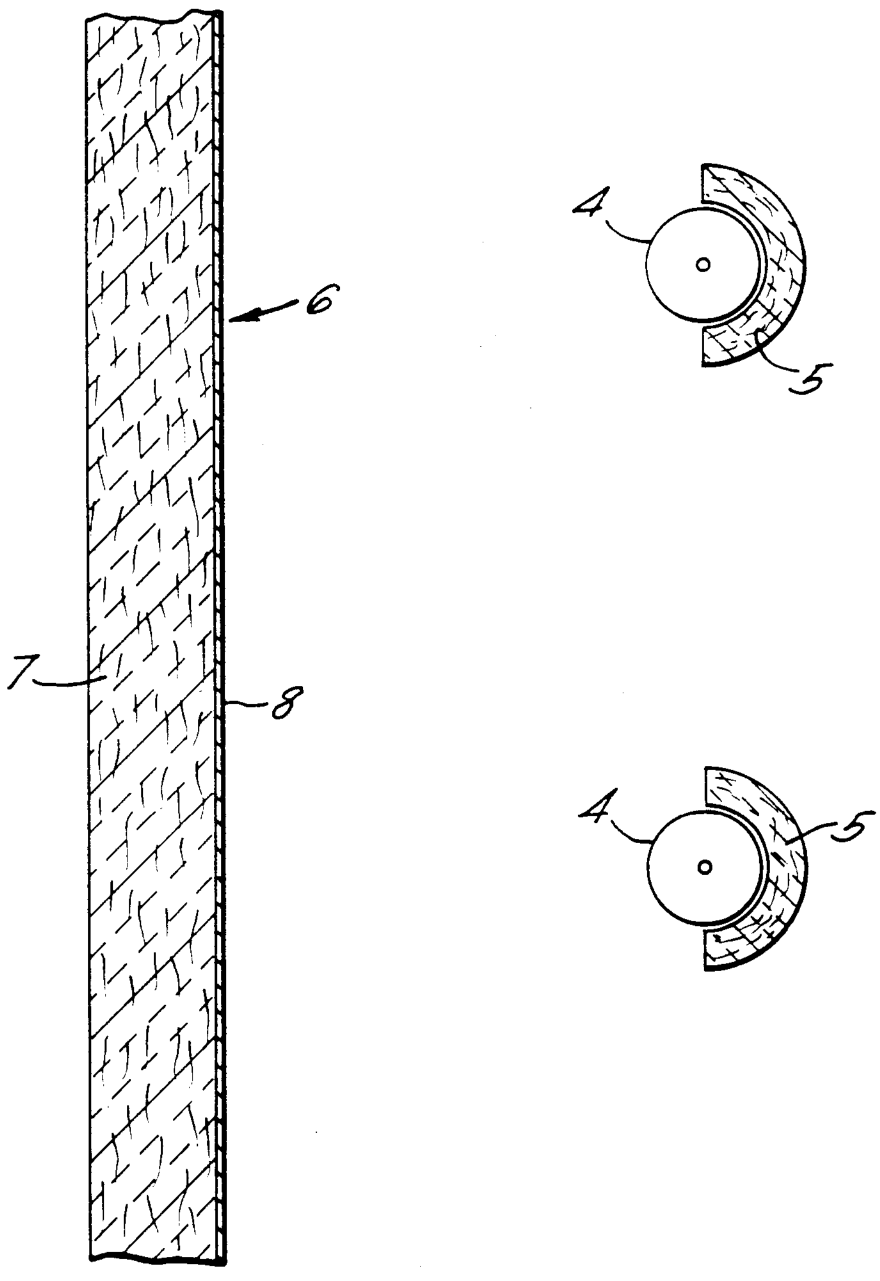


FIG. 4.

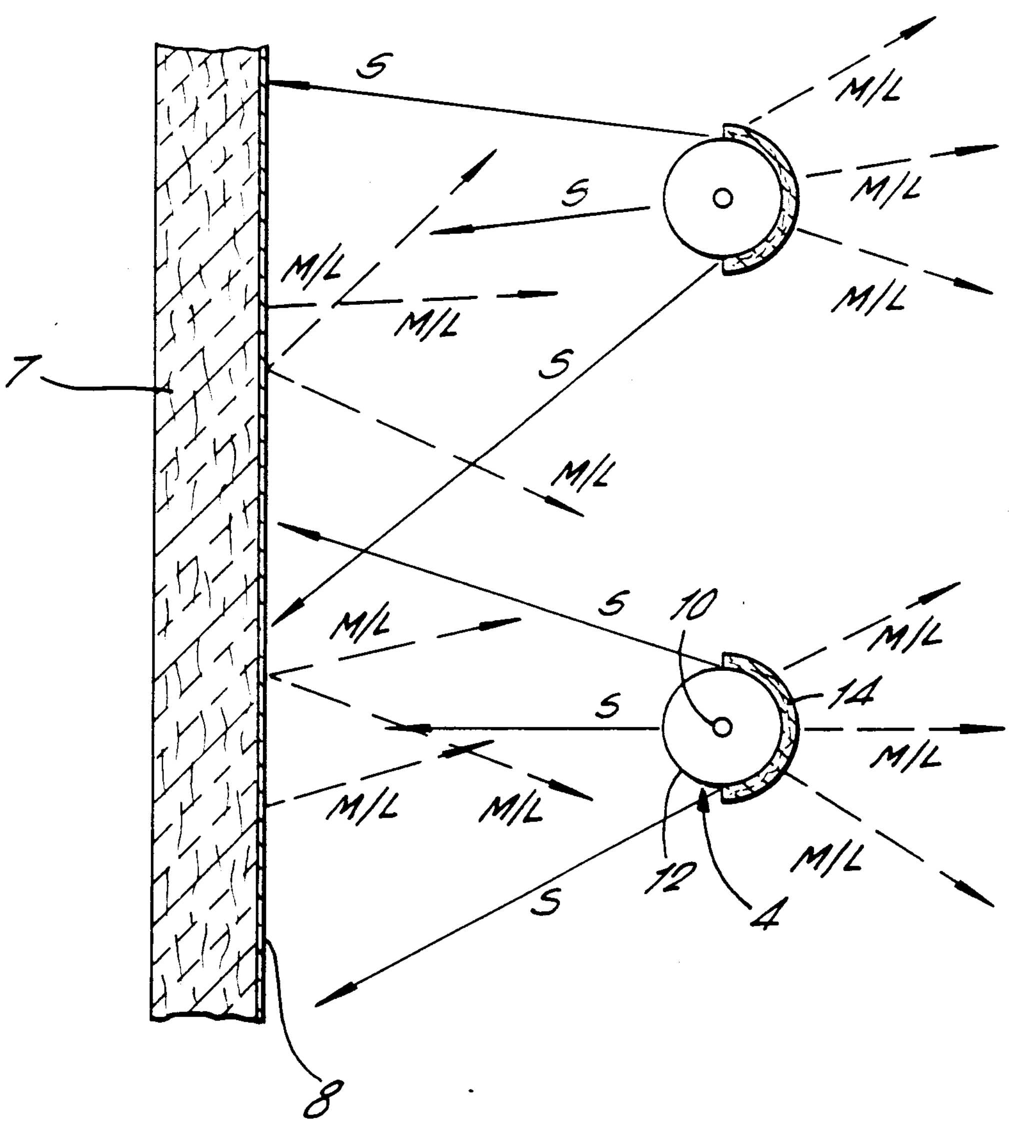


FIG. 5.

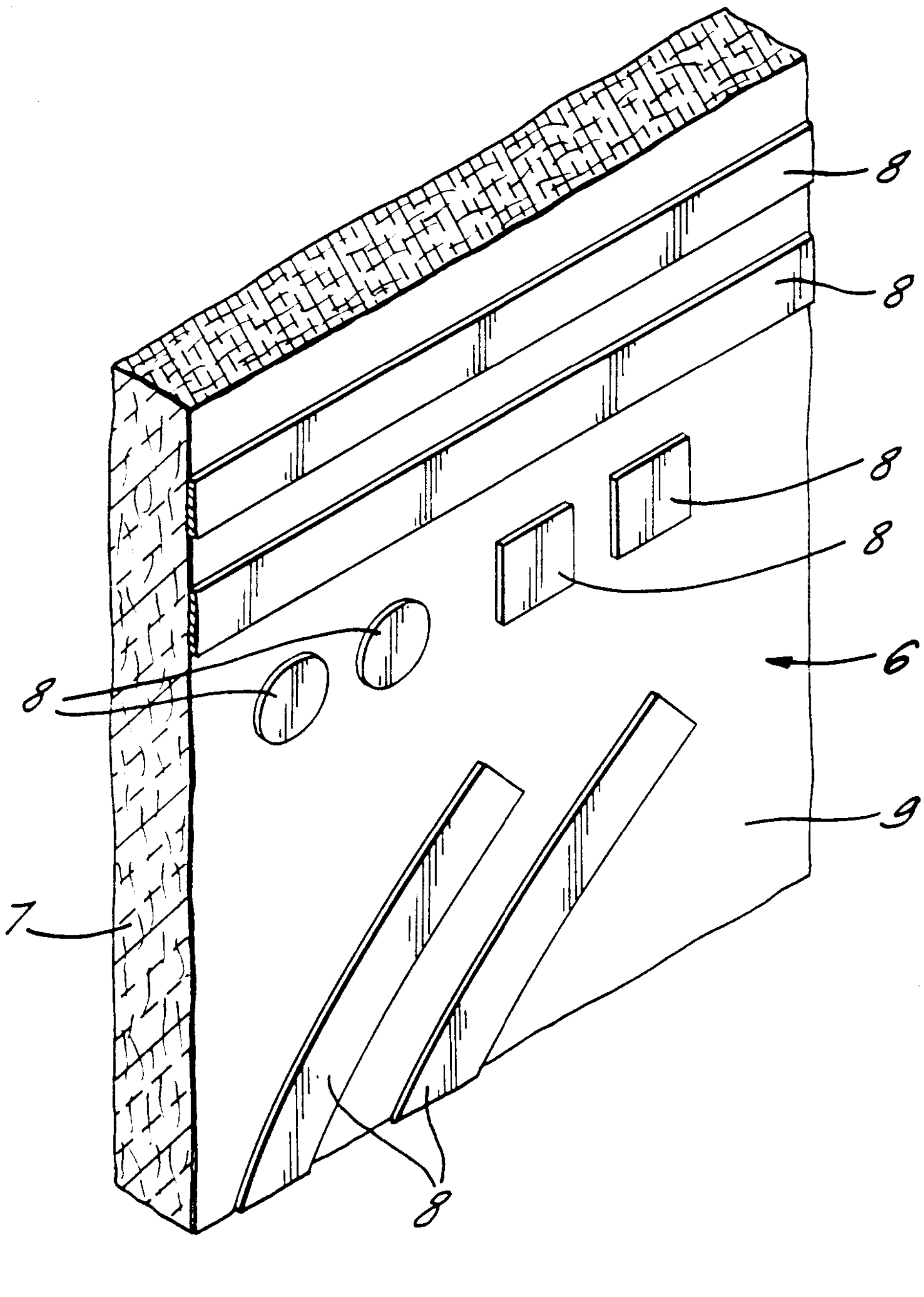


FIG. 6.

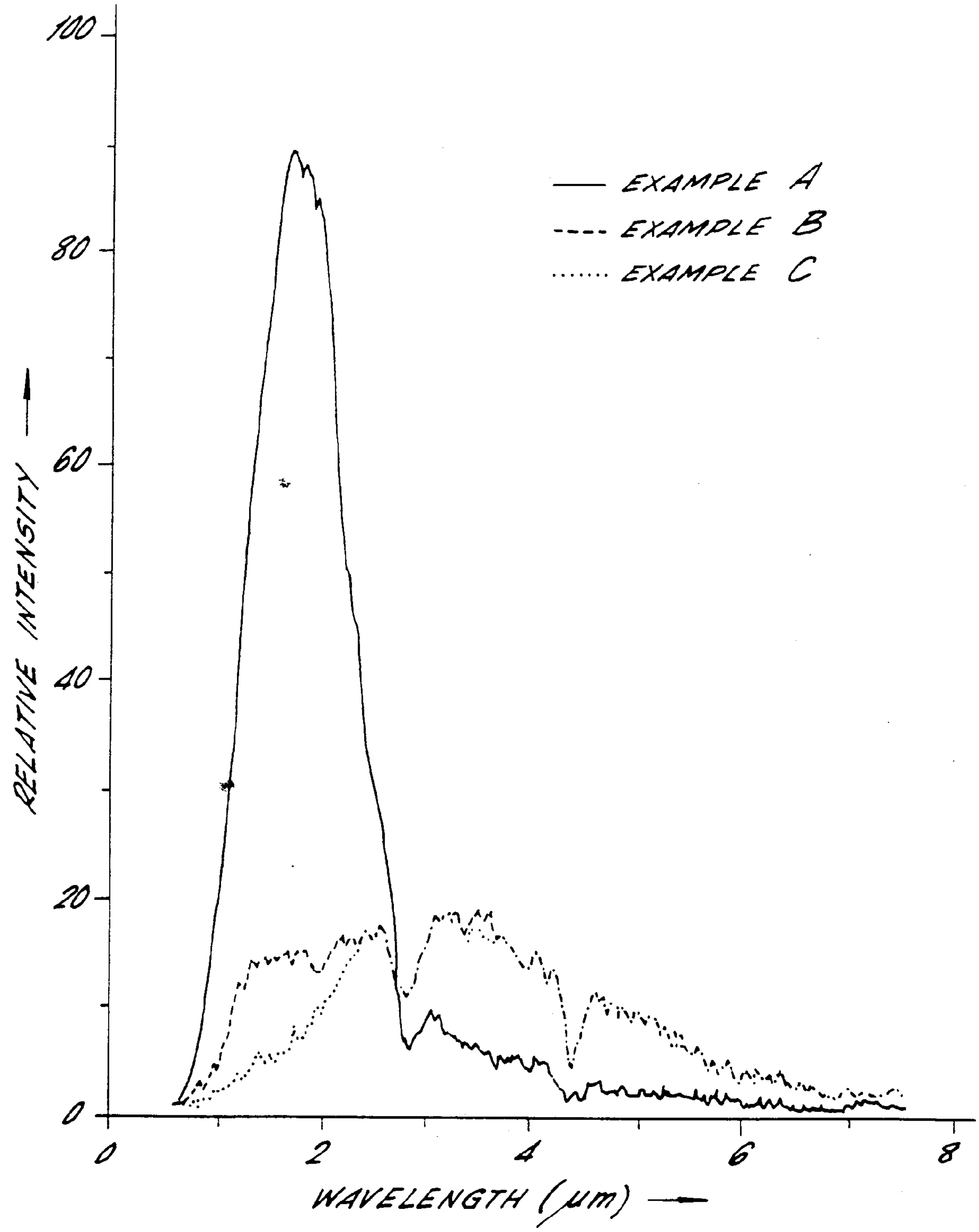

100
80
60
40
20
0
RELATIVE INTENSITY
EXAMPLE A
EXAMPLE B
EXAMPLE C
0
2
4
6
8
WAVELENGTH (μm)

FIG. 7.

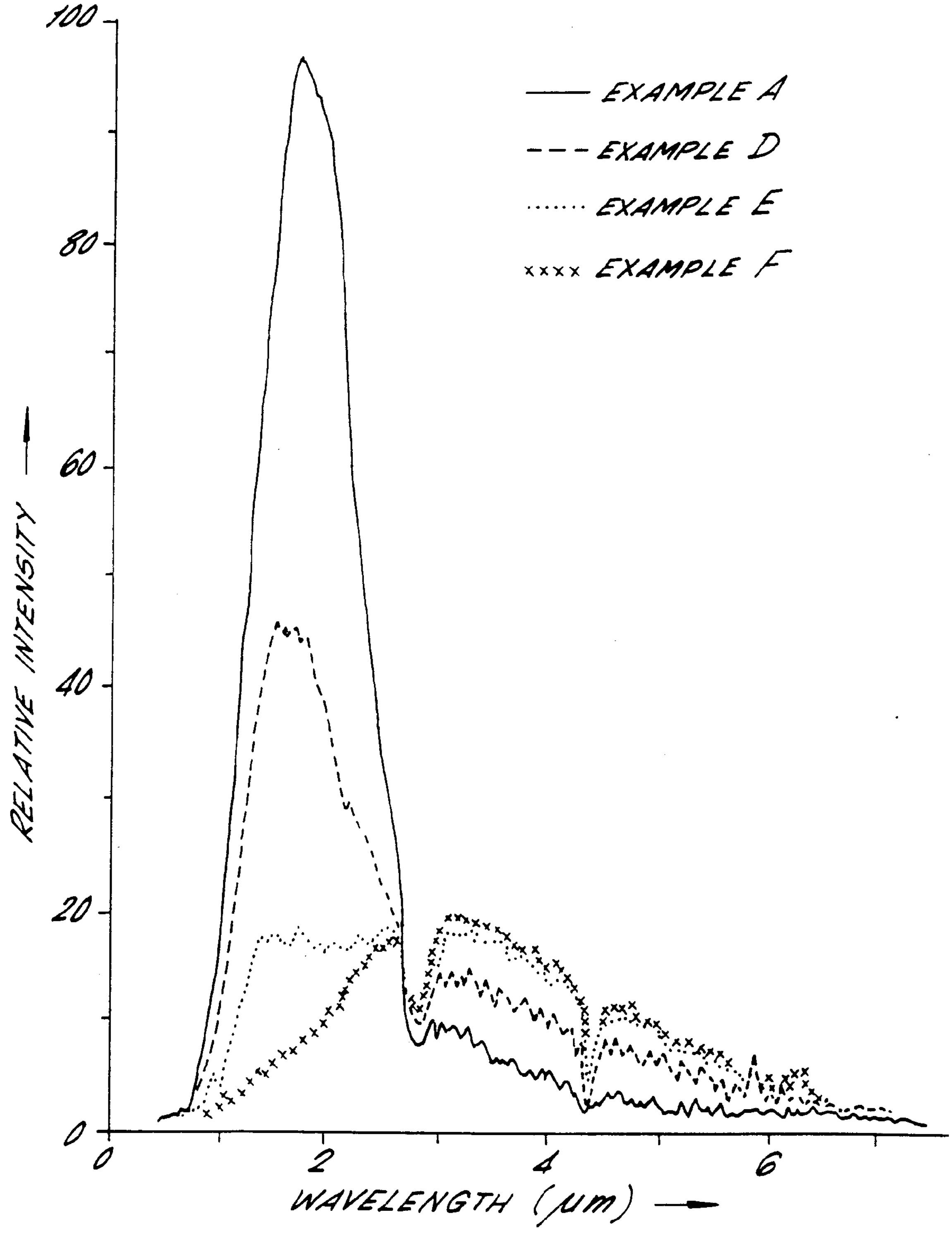
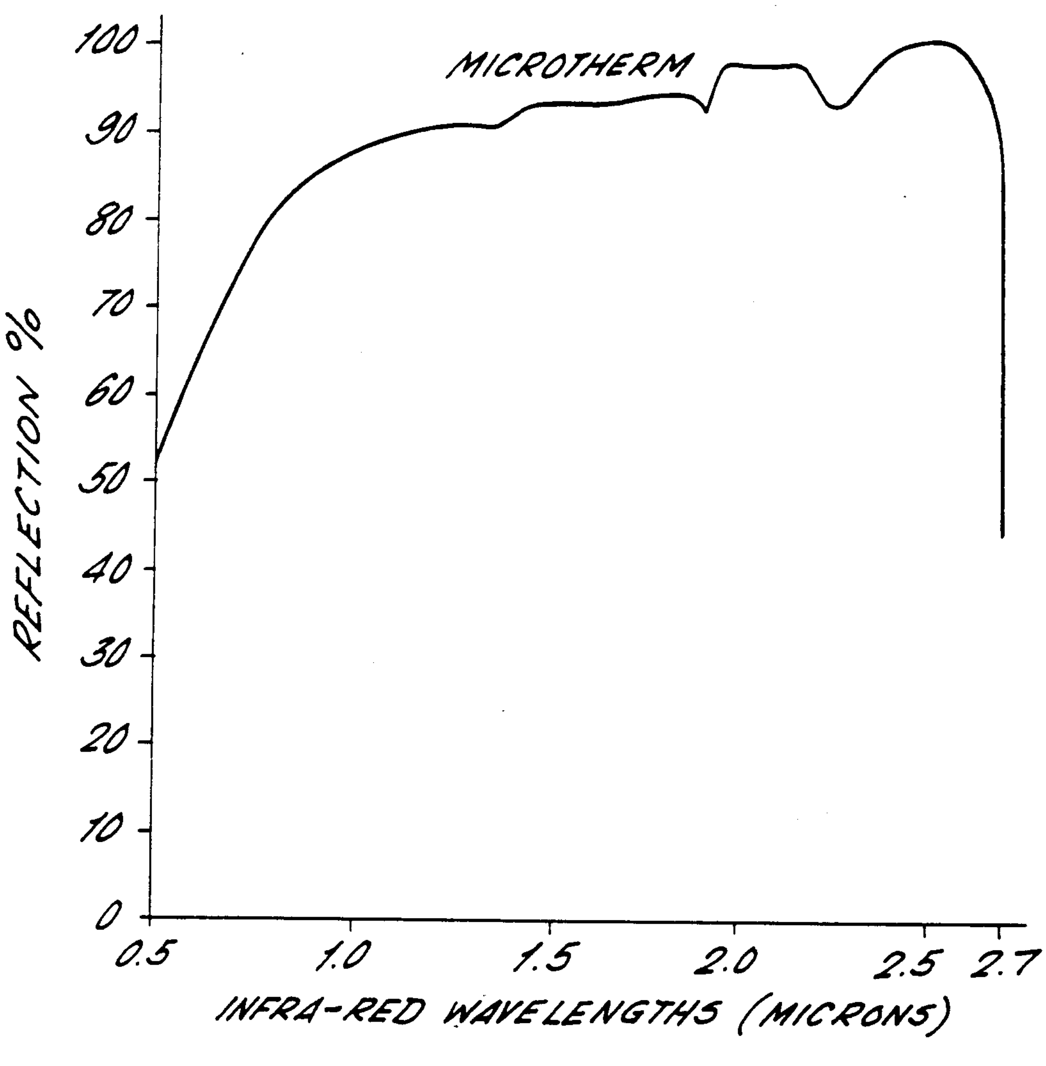

100
80
60
40
20
0
RELATIVE INTENSITY
0
2
4
6
WAVELENGTH (μm)
EXAMPLE A
EXAMPLE D
EXAMPLE E
EXAMPLE F

FIG. 8.


MICROTHERM
100
90
80
70
60
50
40
30
20
10
0
REFLECTION %
0.5
1.0
1.5
2.0
2.5
2.7
INFRA-RED WAVELENGTHS (MICRONS)