

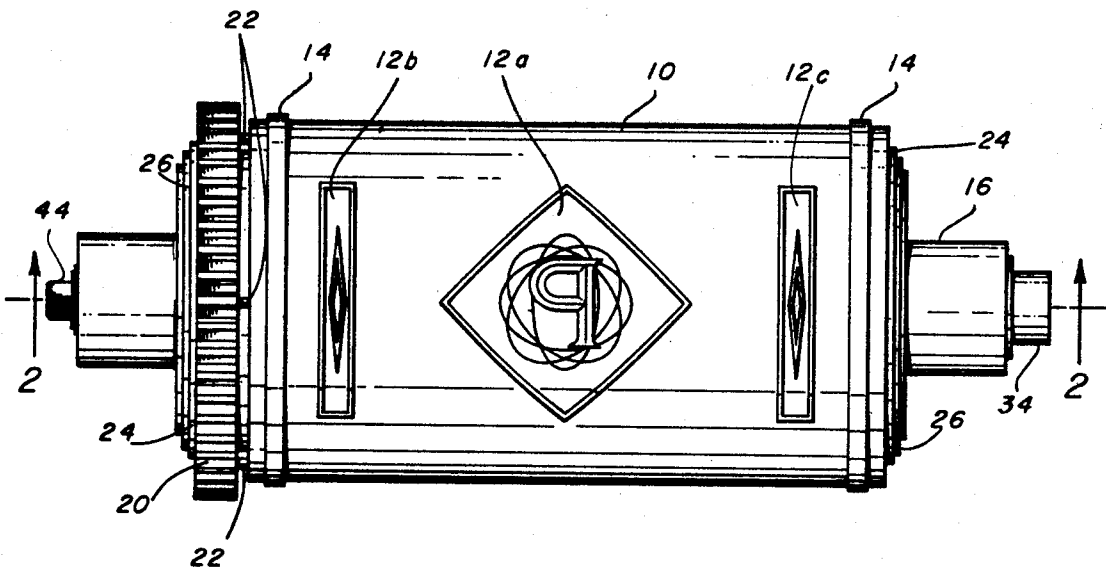
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[56] **References Cited**
UNITED STATES PATENTS
3,129,755 4/1964 Gould et al. 165/89
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[54] **HEAT TRANSFER DEVICE**
6 Claims, 2 Drawing Figs.

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165/185; 219/469
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89, 90, 185; 219/469

ABSTRACT: A heat-transfer device comprises a temperature-controlled support member and a transfer member movably supported in spaced relationship thereupon. Bearing members are interposed therebetween to facilitate movement of the transfer member and to conduct heat between it and limited areas of the support member.



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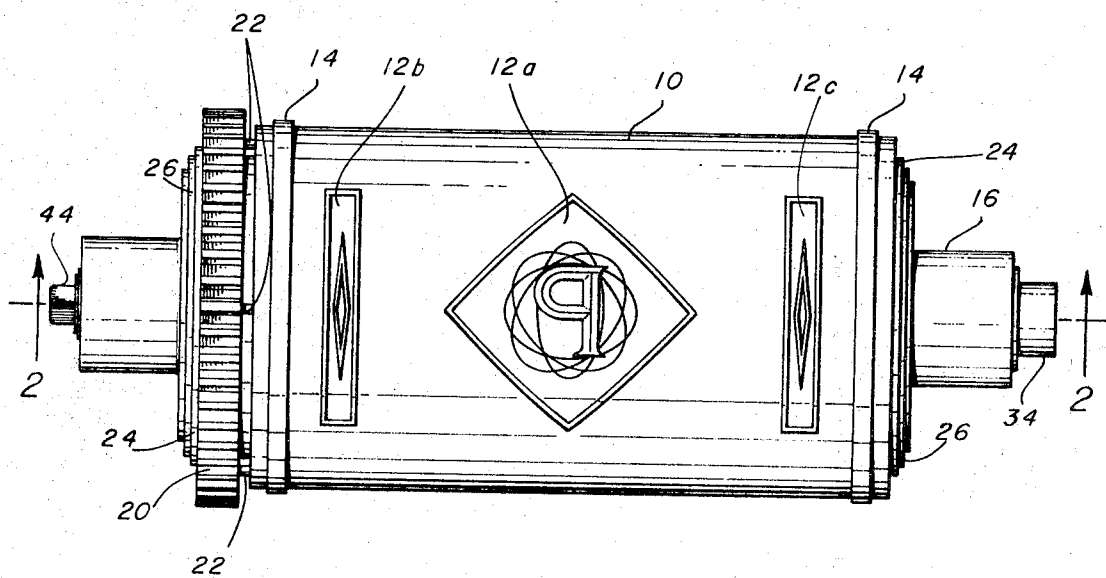


Fig. 1

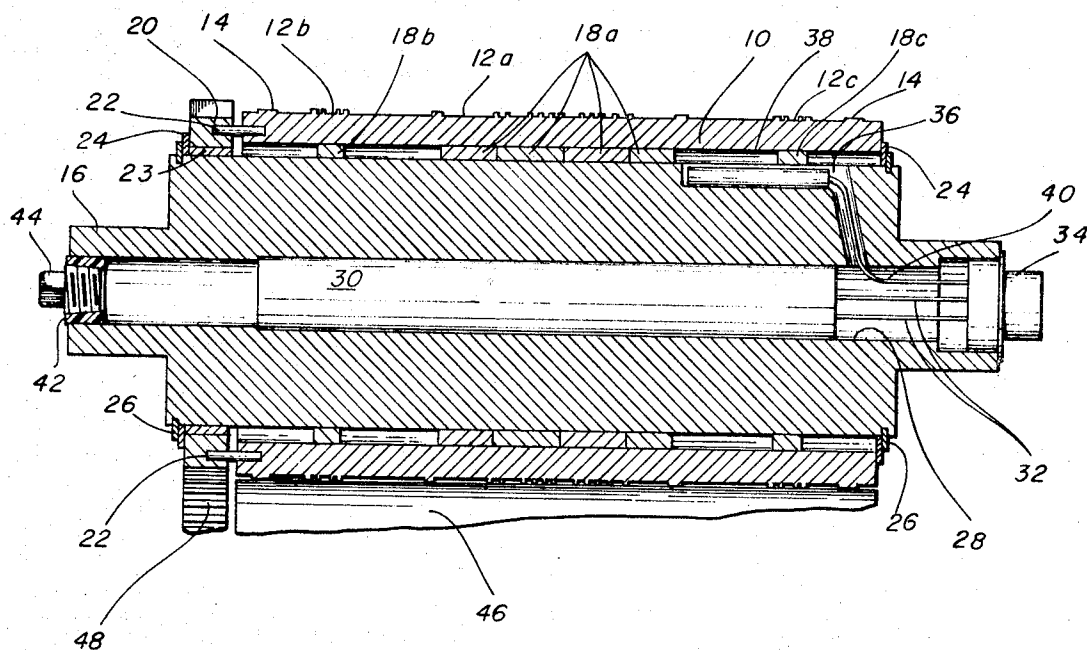


Fig. 2

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HEAT TRANSFER DEVICE

BACKGROUND OF THE INVENTION

Movable heat transfer devices such as rotatable rolls, slidable plates and the like are well known and have been utilized in the past for a wide variety of purposes. In most instances, they are employed to conduct heat from a suitable source to a desired object or surface; in some instances, however, it may be desirable to conduct heat away from such an object or surface to a heat sink. Devices for positive heat transfer are employed for various purposes including the drying of web materials or freshly printed surfaces, the lamination of films, the lamination of tubes of paper or the like, heat sealing, hot stamping, embossing, die cutting, etc.

Although devices of many different designs have been utilized in such operations, one major drawback inherent in many of the prior art devices stems from the fact that they are generally designed so that the entire structure rotates or moves relative to a support, which makes it difficult in some instances to effect satisfactory connections for heating or cooling of the transfer surface. This drawback has been alleviated somewhat in electrically heated rolls by the use of slipping or similar types of electrical connectors, but the sliding contact involved introduces somewhat undesirable limitations of its own. It may also be desirable in some instances to heat or cool the roll with a fluid such as steam or a refrigerant, and so far as it is known no entirely satisfactory device of the type herein described has been provided which can be heated or cooled in such a manner.

In addition, although it is most desirable for some purposes to maintain the entire width of the heat transfer member at essentially the same temperature, there are cases in which it is more desirable to provide areas at different temperatures thereon. For example, when the device is utilized for hot stamping, only the portion of the transfer surface which carries the impression need be heated. Heating of the entire surface is inefficient in terms of energy utilization, and unnecessarily exposes portions of the web or equipment to the effects of elevated temperatures, which may be detrimental.

Accordingly, it is an object of the present invention to provide a heat transfer device wherein the transfer member is movable relative to a temperature-controlled support member so as to provide a heat transfer path and to allow ready installation in, and/or adaptation to, existing and conventional apparatus.

It is also an object to provide such a device wherein the heat transfer member is supported for movement relative to the support member for efficient heat transfer by simple and economical means.

Another object is to provide a device of the type described wherein different temperatures may be maintained across the width of the transfer member to effect the desired amount of heat transfer at preselected portions thereof, so as to utilize a heat source or sink most efficiently and to protect portions of the web and device from undue exposure to undesirable temperature effects.

SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects are readily attained in a heat transfer device comprising a support member with temperature control means, a bearing member of thermally conductive material in surface contact thereon, and a transfer member supported in surface contact upon the bearing member. The transfer member is in spaced relationship to the support member and movable relative thereto with the bearing member interposed therebetween. The bearing member is lesser in dimension than the transfer member normal to the direction of relative movement, so as to conduct heat therebetween only at a limited portion of the transfer member.

Preferably, the support member is a generally stationary shaft, and a generally annular bearing member supports a cylindrical sleeve or transfer member for rotation relative to

the shaft. It will be appreciated that the device may include a plurality of bearing members axially aligned at spaced locations along the shaft to conduct heat at a plurality of spaced portions of the sleeve, with the total axial dimension of the bearing members being lesser than that of the sleeve in order to achieve localization of direct heat conduction. In one embodiment, the support member includes heating means for maintaining it at a temperature above ambient, and one or more zones of raised indicia may be provided on the outer surface of the transfer member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of a heat transfer device embodying the present invention; and

FIG. 2 is a sectional view thereof along the line 2-2 of FIG. 1 and showing the assembly therewith of a fragmentarily illustrated pressure roll and drive gear.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Turning now in detail to the drawing, the heat transfer device embodying the present invention comprises a cylindrical transfer roll 10 having three zones 12a, b, c of printing indicia spaced axially along the outer surface thereof. A pair of bearers 14 is also provided on the transfer roll 10, one of which is positioned adjacent each end thereof for a purpose to be more fully described hereinafter. The transfer roll 10 is rotatably mounted upon a hollow cylindrical shaft 16 by means of the multiplicity of heat-conductive annular bearings 18a, b, c interposed therebetween. These bearings 18 are press-fitted into the roll 10 and bear directly upon the shaft 16 to provide efficient heat transfer contact with the surfaces of both members. In this manner, they serve both to provide heat transfer means therebetween and also to provide low friction surfaces for rotation of the transfer roll 10 on the shaft 16.

A drive gear 20 is coaxially mounted on the shaft 16 adjacent one end of the transfer roll 10 and is mechanically engaged therewith by a plurality of axially extending coupling pins 22 so that the drive gear 20 provides motivation for the transfer roll 10. The drive gear 20 is rotatably supported on the bearing 23 to provide a sliding contact surface for the gear bearing upon the shaft 16. The drive gear 20 and the transfer roll 10 are secured in axial position on the shaft 16 by a pair of thrust bearings 24 and the associated snap ring bearings 26 which are seated in suitable grooves provided adjacent each end of the shaft 16.

Mounted within the bore 28 of the shaft 16 is an electrical heating element 30 which has a pair of electrical leads 32 extending to a female electrical connector 34. As will be appreciated, the electrical connector 34 is designed for union with a cooperating male connector to provide electrical power from a suitable source (not shown). An elongated recess 36 is provided in the outer surface of the shaft 16 and seats a temperature sensor 38 such as a thermocouple or the like. The sensor 38 has an electrically conductive lead 40 into the electrical connector 34 and provides a signal to suitable temperature indicating or control means, preferably of the type which will automatically regulate the flow of current to the heating element 30 in order to maintain the temperature at the exterior of the shaft 16 essentially constant at the preselected temperature. At the end of the shaft 16 opposite to that in which the electrical connector 34 is mounted is a nonmetallic sealing element 42 and a plug 44 which may be removed to facilitate disassembly of the various parts.

A typical environment for the heat transfer device is illustrated fragmentarily in FIG. 2 by the cooperating pressure roll 46 positioned below the heat transfer roll 10 and the drive gear 48 meshing with the drive gear 20. Normally, the cooperating pressure roll 46 would be driven and the power transmitted therefrom through the drive gear 48 to the gear 20, with the material or web to be treated passing through the nip between the rolls 10, 46.

The advantages of the present invention should be readily apparent from the illustrated embodiment hereinbefore described in detail. The bearings 18a tend to localize maximum effective heat transfer to the corresponding zone 12a of printing indicia on the surface of the transfer roll 10. Similarly, the bearings 18b and 18c tend to localize maximum effective heat transfer to the print indicia zones 12b and 12c respectively. This localization of maximum effective heat transfer results in highly efficient utilization of energy furnished to the heating element 30 within the shaft 16. The spaces between the bearings 18a, 18b and 18c, and between the bearings 18b and 18c and the thrust washers 24 serve to enhance the localization of heat transfer at the surface of the transfer roll 10. The bearers 14, which are raised ribs extending entirely about the transfer roll 10 adjacent each end thereof, serve a two-fold purpose. Firstly, they tend to ensure parallel axis alignment of the two rolls at the nip and thus provide equal pressure across the entire length of the roll and provide additional contact surface so as to protect the printing indicia and the article printed from damage due to high pressures; secondly, they facilitate proper axial alignment of the transfer roll by permitting a visual inspection of the impression of the bearers on a web which is passed therebeneath in a preliminary step. These bearers will normally be slightly more in height than the printing indicia on the transfer member, and may be spaced a considerable distance inwardly from the ends of the roll.

As will be apparent, the number of heat-transfer bearings provided will depend primarily upon the pattern of heat transfer which is desired and the design of indicia on the outer surface of the transfer member. A multiplicity of such bearing members may be grouped together, or a single bearing member equivalent in axial length may be substituted therefor. Although the devices of the present invention may be utilized to provide only one heat transfer zone on the surface of the transfer member, they are most valuably employed to effect heating or cooling at a plurality of axially spaced zones.

The specific configuration and construction of the bearing members per se is not critical to the invention, although annular elements such as are shown in the drawing are particularly suitable for use in the present device because they are highly efficient in distributing heat energy to the desired locations. The bearings should be fabricated of a durable material which has good wear characteristics coupled with a desirable heat-transfer coefficient; metal alloys such as brass or bronze may advantageously be employed, and bearings coated with polymers providing a high-temperature lubricating effect are particularly desirable. The bearings may be press fit onto the support or into the transfer member or other conventional means may be used to secure them therebetween, depending upon the nature of the bearings and the overall design of the device.

As has been mentioned, the device of the invention will most often be employed to convey heat from a source within the device to a web material; however, there are cases in which it may be used to conduct heat from such an object to a heat sink contained within the device. For example, a cooled transfer roll may be used in conjunction with a heated pressure roll to provide areas of heating and cooling for the web therebetween along the respective surfaces thereof or to produce variations from one surface to the other of the web at selected points across the width of the web.

The temperature controlled support member will be provided with suitable means for heating or cooling thereof depending upon its intended application. Although the optimum levels of controlled heating may best be achieved by the use of electrical heating elements, such as that shown in the drawing, other means for heating the roll may be utilized, such as steam or other heated fluid conveyed through the support member with fittings at the ends thereof; in a similar manner, the device may be cooled by passing a refrigerant through such conduits. It will be appreciated that whatever temperature control medium is used, the support member will be designed

to accommodate suitable connectors to convey the medium from a source to the interior of the support member, and such connectors or the like may comprise the temperature control means for the support member.

Although the support member is generally stationary, it may be designed for limited movement, such as to adjust the device relative to the article or surface which is to be treated, as may be necessary during initial insertion of the web between the rolls or thereafter. The essential feature of the devices of the invention is that the transfer surface be movable relative to the support member thereof so that movement of the support member can be limited in a manner that will greatly facilitate mounting and adaptation of the device to conventional and existing equipment. The support member need not be cylindrical, as it is shown to be in the drawing, but may have virtually any configuration permitting relative movement of the transfer member in the desired manner. Similarly, although cylindrical transfer members may be most suitable in the majority of applications, noncylindrical members may also be used; thus, the transfer member may be a flat or arcuate die which simply moves transversely relative to the adjacent surface of the support member. The materials of which the transfer and support members are constructed are not critical to the invention and will be apparent to those skilled in the art but the materials must be thermally conductive at least at the selected areas; more particularly, they should have good heat transfer coefficients coupled with high levels of structural strength and durability. As an example, it has been found to be advantageous to construct the center shaft of stainless steel and the rotatable cylinder of bronze.

Although the dimensions of the various portions of the device may vary considerably, the relationship between the dimensions of the transfer member and the bearing members is quite important. Thus, since the path of heat transfer tends to widen during travel through the heat transfer member from the bearing members, if the transfer member is made of only one material, the transfer member should be relatively thin to minimize the extent of the spread. Also, when a number of indicia zones are present on the transfer roll, the spacing between respective underlying bearing members should be maximized and the width of the bearing member should be somewhat less than that of the related indicium to compensate for the widening of the heat transfer path and to thereby maintain the zones of different temperatures as distinct as possible. It will also be seen that the thickness of the transfer member should be less than the spacing between bearing members intended to provide relatively distinct zones of different temperatures.

Accordingly, it can be seen that the present invention provides a heat transfer device wherein the transfer member is movable relative to a temperature-controlled support member so as to provide a heat transfer path and to allow ready installation in, and/or adaptation to, existing and conventional apparatus. In the device, the heat transfer member is supported for movement relative to the support member for efficient heat transfer by simple and economical means. Different temperatures may be maintained across the width of the transfer member to effect the desired amount of heat transfer at preselected portions thereof. Thus, the heat source or sink is most efficiently utilized and portions of the web and device are protected from undue exposure to undesirable temperature effects.

I claim:

1. A heat transfer device comprising a support member with a temperature control means for at least a portion thereof, a bearing member of thermally conductive material overlying said temperature controlled portion of said support member, and a transfer member supported in surface contact upon said bearing member in spaced relationship relative to said support member and movable relative thereto, said transfer member having its outer surface exposed for contact with a web material for heat transfer therebetween, and said bearing member having a substantial width but being narrower than

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said transfer member in a direction perpendicular to the direction of relative movement, said bearing member conducting heat between said support member and transfer member only at a limited portion of said transfer member and establishing a temperature gradient across the width thereof.

2. The device of claim 1 wherein said support member includes heating means providing said temperature control means and maintaining said temperature controlled portion at a temperature above ambient.

3. The device of claim 1 wherein said support member is a generally stationary shaft, wherein said bearing member is generally annular and wherein said transfer member is a cylindrical sleeve supported on said bearing member for rotation relative to said shaft, the widths of said bearing member and

transfer member being along the axes thereof.

4. The device of claim 3 wherein a plurality of said bearing members are disposed at spaced locations along said temperature controlled portion of said shaft to conduct heat at a plurality of spaced portions of said sleeve, the total axial dimension of said bearing members being less than that of said sleeve, and at least one of said spaced portions of said sleeve being intermediate the ends thereof.

5. The device of claim 1 wherein said transfer member has at least one zone of raised indicia on the outer surface thereof.

6. The device of claim 4 wherein a zone of raised indicia is present on the outer surface of each of said portions of said sleeve.

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