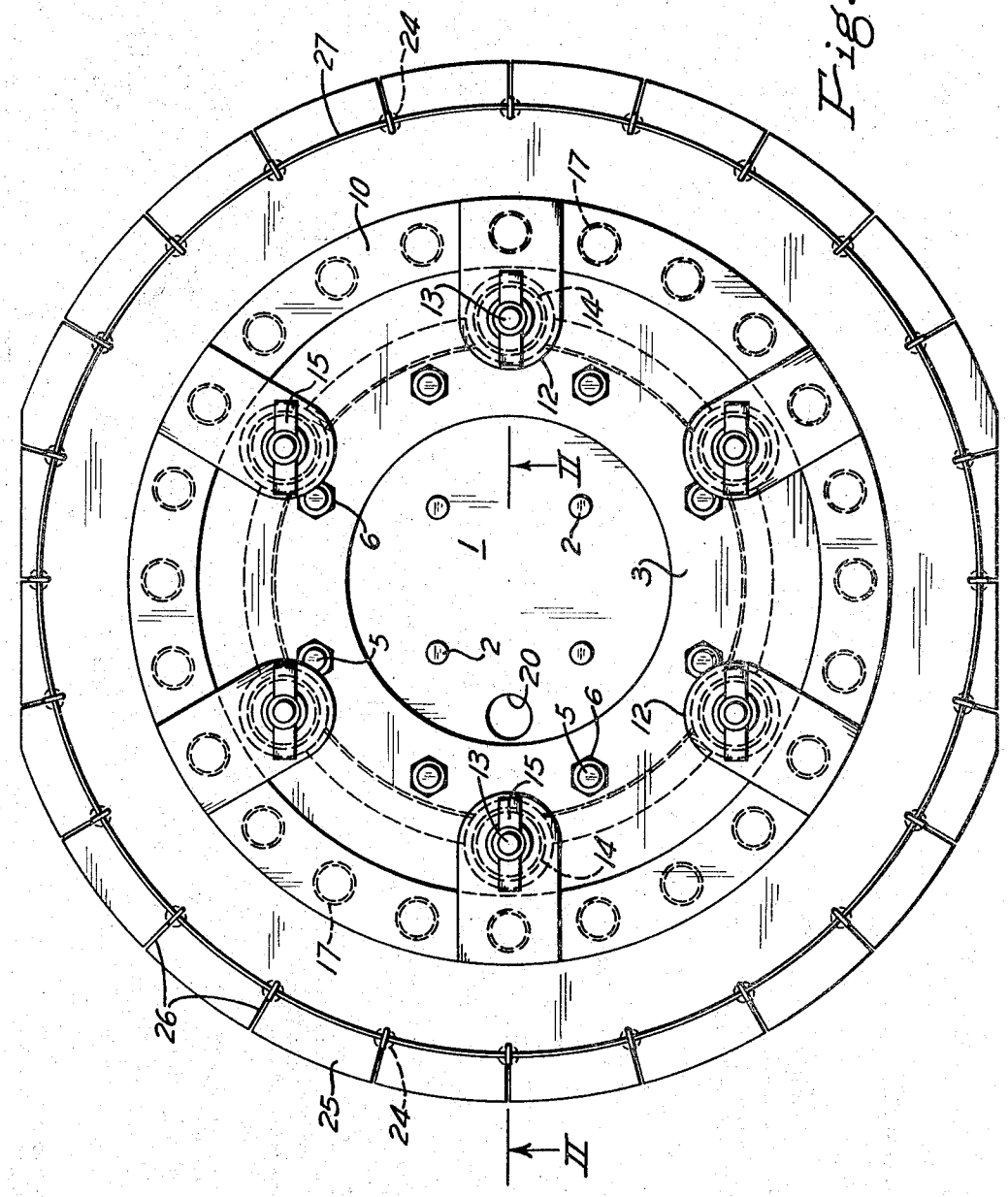
March 7, 1967 R. M. WARFEL 3,307,869

VACUUM LIFTING PAD

Filed March 15, 1965 2 Sheets-Sheet 1

Fig. 1



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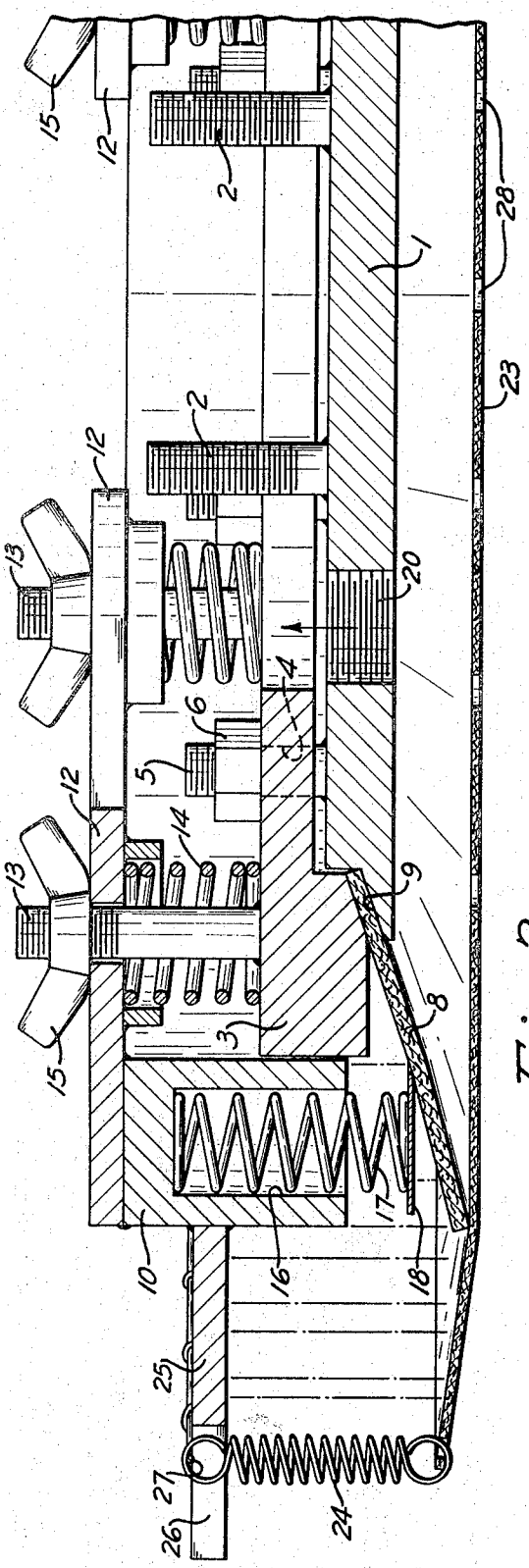

Fig. 2

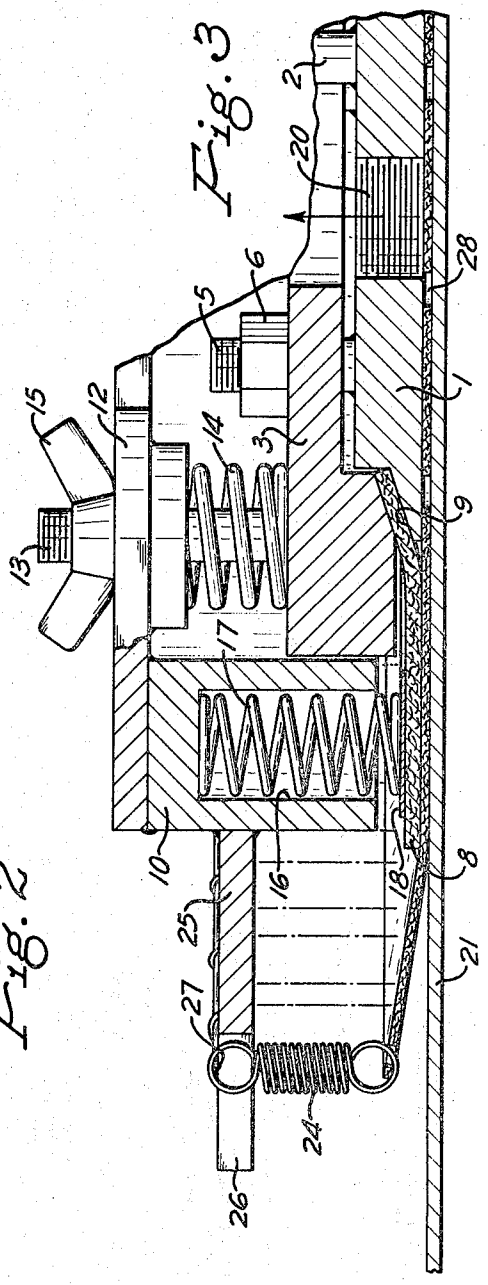

Fig. 3

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VACUUM LIFTING PAD

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This invention relates to vacuum lifting pads, and more particularly to those used for lifting hot or highly polished material.

It is among the objects of this invention to provide a vacuum lifting pad which can handle metal sheets and plates that are at a very high temperature, which can handle such materials or highly polished sheets and plates without marking their surfaces, which lifts loads safely, which is adjustable for lifting thick or thin sheets safely and without deforming them, which is provided with an inexpensive sealing ring, and in which the sealing ring is readily replaceable.

In accordance with this invention a flexible sealing ring is secured to a substantially horizontal supporting member that is adapted to be raised and lowered in order to lift and lower a load. The sealing ring has a free area extending downward from the supporting member and outward. Spring means are carried by the supporting member for engaging the upper surface of the ring in order to resist its upward flexing. Preferably, the spring means are adjustable vertically. The supporting member is provided with an evacuating opening that is surrounded by the ring. The sealing ring is formed from a flat sheet of material, preferably asbestos sheet when high temperature loads are to be lifted. To avoid marking the load due to sliding of the outer edge of the sealing ring against it, a flexible base sheet may be disposed below the supporting member and extend laterally out beyond the sealing ring. Springs depending from the supporting member support the edge of this sheet above the level of the free edge of the sealing ring. The base sheet is provided with one or more openings within the area surrounded by the outer edge of the sealing ring so that the vacuum in the pad can be applied to the load for lifting it.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. 1 is a plan view of my lifting pad;

FIG. 2 is an enlarged fragmentary vertical section taken on the line II—II of FIG. 1; and

FIG. 3 is a similar section, but showing the pad applied to a metal plate for lifting the plate.

Referring to FIGS. 1 and 2 of the drawings, the lifting pad includes a supporting member, the central portion of which is formed from a rigid plate **1** that is provided with upwardly extending threaded studs **2** for connection to conventional means for lowering and raising the supporting member. The plate supports a surrounding clamping ring **3** that also forms part of the supporting member. The plate may be any desired shape, the one shown being circular. Consequently, the ring also is circular. The inner marginal portion of the ring overlaps the margin of the plate and is provided with holes **4**, through which extend threaded studs **5** secured to the top of the plate. Nuts **6** are screwed onto the studs to connect the ring and plate together.

A flexible sealing ring **8** is secured to the supporting member and extends below it. The sealing ring is secured to the supporting member in an area that is spaced inwardly from the outer edge of the sealing ring, and from that area the ring extends downward and outward. Preferably, the sealing ring is annular and has been stamped out of a flat sheet of material suitable for the

purpose for which the lifting pad is to be used. For use with hot material, the sealing ring can be made from asbestos. For other uses, the ring may be made of rubber, synthetic plastic or the like. The sealing ring is attached to the supporting member by clamping the inner edge portion of the ring between clamping ring **3** and the plate **1**. For this purpose the marginal portion of the plate is stepped down and provided with a downwardly and outwardly inclined upper surface. The bottom of the clamping ring above that surface is inclined to the same extent so that a conical slot **9** is provided between them. The inner marginal portion of the sealing ring is disposed in this slot and clamped between its inclined walls by tightening the nuts on studs **5**. This deforms the sealing ring into the desired conical shape. The ring is wide enough to extend out beneath the clamping ring and also beneath a socket ring **10** encircling the clamping ring and forming part of the supporting member.

The socket ring may be secured rigidly to the clamping ring, but preferably it is adjustably connected to it. Thus, the top of the socket ring may be provided with several circumferentially spaced lugs **12** that project inwardly over the clamping ring and are slidable vertically on threaded studs **13** extending up through them from the clamping ring. The lugs and clamping ring are separated by coil springs **14** encircling the studs between them. Thumb nuts **15** are screwed onto the upper ends of the studs to hold the lugs tightly against the springs and to compress the springs the desired amount. The socket **16** in the socket ring open downwardly and contain coil springs **17** that project beneath the ring and engage the top of a thin resilient ring **18** seated on top of the sealing ring.

The central plate **1** is provided with an opening **20**, to which a hose (not shown) is connected for withdrawing air in the usual manner to evacuate the space encircled by the sealing ring. When the lifting pad is in use, the lower surfaces of plate **1** and the sealing ring will tend to be drawn into the same plane as shown in FIG. 3. Since the sealing ring has a substantially uniform thickness throughout with no stiffening lip around its lower edge, and since the ring may be non-resilient anyway, the lower edge of the ring might not make sealing contact with the underlying sheet **21** that is to be lifted, if it were not for springs **17**. These springs, by pressing ring **18** down on the sealing ring, resist upward flexing of the lower marginal portion of the sealing ring and thereby ensure that it will form a good seal. They also help return a non-resilient sealing ring to its conical form after it has been flattened during lifting of a load.

When a heavy sheet or plate is to be lifted, thumb nuts **15** should be turned down on studs **13** to lower the socket ring relative to plate **1**, whereby the springs **17** will exert more pressure against the sealing ring during lifting of the load. On the other hand, if a light flexible sheet is to be lifted, the socket ring should be adjusted upwardly so that its springs will not exert so much pressure against the sealing ring, as that could hold the sealing ring below the bottom plane of the central plate so that the area of the sheet beneath the plate would be drawn upwardly relative to the surrounding area, resulting in "oil canning" the sheet.

Another feature of this invention is that the outer edge of the sealing ring can be prevented from sliding on the load as the vacuum is applied and released. Otherwise, the sealing ring may mark the sheets being lifted if they are, for example, hot aluminum or polished stainless steel. Accordingly, a thin flexible base sheet **23** of suitable material, such as asbestos when hot loads are being handled, is provided which has a larger diameter than the sealing ring. This sheet is disposed below the sealing ring and center plate and extends laterally out beyond the ring,

which it engages. The edge of the sheet is supported by oil springs 24 hanging from the outer edge of an outer ing 25 encircling the socket ring and fastened to it to orm part of the supporting member. These springs may e connected to the outer ring by providing their upper nds with vertical loops that extend up through radial lots 26 in the edge of the ring. A strong wire 27 is trung through all of the loops above the ring and thereby prevents them from being pulled down through the slots. The springs are short enough to require that they be expanded by base sheet 23, to the outer edge of which they are connected. The tendency of these springs to contract holds the portion of the base sheet outside of the sealing ring at an upward inclination to the rest of the sheet, so that neither the springs nor the outer edge of the sheet will touch the load. The portion of the base sheet that is within the area surrounded by the outer edge of the sealing ring is provided with one or more openings 28 to connect the low pressure area of the pad with the material to be lifted. When this pad is set down on a load 21 and vacuum is applied, the outer edge of the sealing ring slides outward on top of the base sheet instead of on the load itself, as the sealing ring is flattened. As the sealing ring is flattened, springs 24 lift the outer edge of the base sheet to keep it away from the load so that it will not mark the upper surface of the load.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A vacuum lifting pad, comprising a substantially horizontal supporting member adapted to be raised and lowered, a flexible sheet-like sealing ring beneath said member secured thereto in an area spaced inwardly from the outer edge of the ring, the ring extending downward from the supporting member and outward, and separate spring means carried by said member for engaging the upper surface of said ring to resist upward flexing of the ring, said supporting member being provided with an evacuating opening surrounded by said ring.

2. A vacuum lifting pad according to claim 1, in which said sealing ring has a substantially uniform thickness throughout its area.

3. A vacuum lifting pad according to claim 1, in which said spring means include an endless row of laterally spaced vertical coil springs, and a resilient ring seated on the sealing ring and engaged by the lower ends of the springs, the springs being compressible between said supporting member and resilient ring.

4. A vacuum lifting pad according to claim 3, in which said supporting member is provided with a plurality of laterally spaced downwardly opening sockets containing the upper ends of said coil springs.

5. A vacuum lifting pad according to claim 1, in which said sealing ring originally is flat, and said supporting member is provided in its bottom with a conical slot receiving and holding the inner edge portion of the ring to deform the ring into conical shape.

6. A vacuum lifting pad according to claim 1, in which said sealing ring has inner and outer edges and said supporting member includes a central plate having a surrounding marginal portion provided with a downwardly and outwardly inclined upper surface supporting the inner marginal portion of the sealing ring, a rigid ring surrounding said plate and seated on the sealing ring above said inclined surface, and means attaching the rigid ring and plate together to clamp the sealing ring between them, said plate containing said evacuating opening.

7. A vacuum lifting pad according to claim 1, including means for adjusting said spring means vertically.

8. A vacuum lifting pad according to claim 1, in which said spring means are carried by an annular portion of said supporting member that is adjustable vertically relative to the rest of said member.

9. A vacuum lifting pad according to claim 1, in which said spring means are carried by an annular portion of said supporting member provided with inwardly projecting means overlapping the edge of the rest of said member, said pad including coil springs spacing said inwardly projecting means from the underlying portion of the supporting member, and manually adjustable connecting means for pressing said inwardly projecting means against said coil springs.

10. A vacuum lifting pad, comprising a substantially horizontal supporting member adapted to be raised and lowered, a flexible sealing ring beneath said member secured thereto in an area spaced inwardly from the outer edge of the ring, the ring extending downward from the supporting members and outward, spring means carried by said member for engaging the upper surface of said ring to resist upward flexing of the ring, a flexible base sheet below the supporting member and extending laterally out beyond the sealing ring, and springs depending from the supporting member and supporting the edge of said sheet above the level of the outer edge of the sealing ring, said member being provided with an vacuating opening surrounded by said ring, and said sheet being provided with an opening surrounded by the outer edge of said ring.

11. A vacuum lifting pad according to claim 10, in which said depending springs are laterally spaced vertical coil springs that are held expanded by said base sheet.

12. A vacuum lifting pad according to claim 11, in which the marginal area of said supporting member is provided with a plurality of laterally spaced slots and the upper ends of said coil springs are provided with upright loops extending up through said slots, and a wire engaging the top of said member extends through all of said loops to support the coil springs.

13. A vacuum lifting pad according to claim 10, including means for adjusting said spring means and depending springs vertically simultaneously.

14. A vacuum lifting pad according to claim 10, in which said spring means and depending springs are carried by an annular portion of said supporting member provided with inwardly projecting means overlapping the edge of the rest of said member, said pad including coil springs spacing said inwardly projecting means from the underlying portion of the supporting member, and manually adjustable connecting means for pressing said inwarly projecting means against said coil springs.

15. A vacuum lifting pad according to claim 10, in which said sealing ring and base sheet are made of asbestos.

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