United States Patent [19]

Kreider et al.

[11] **3,847,539**

[45] **Nov. 12, 1974**

[54] **DRIVING MECHANISM FOR VACUUM ELECTRIC FURNACES**

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[22] Filed: **Dec. 3, 1973**

[21] Appl. No.: **420,796**

[52] **U.S. Cl.** **432/121,** 13/31, 432/205

[51] **Int. Cl.** **F27b 9/14,** F27b 11/08

[58] **Field of Search** 432/205, 121, 122; 13/31

[56] **References Cited**

UNITED STATES PATENTS

3,072,392	1/1963	Palmer	432/205
3,737,553	6/1973	Kreider et al.	13/31

Primary Examiner—John J. Camby
Attorney, Agent, or Firm—Zachary T. Wobensmith, 2nd; Zachary T. Wobensmith, III

[57] **ABSTRACT**

A driving mechanism is disclosed particularly for use in advancing work pieces in the interior of a vacuum furnace, the mechanism extending through the furnace wall for motor or manual driving from the exterior of the furnace, the mechanism being replaceable as a unit, having provisions for sealing against fluid leakage and for reduction of heat conductivity between hot and cold locations, for liquid cooling at intermediate locations and for effective heat conductivity at cool locations. Provisions are also made for easy separation if desired of portions subjected to seizure at high heat levels, and for evacuation of interior portions subjected to vacuum.

14 Claims, 6 Drawing Figures

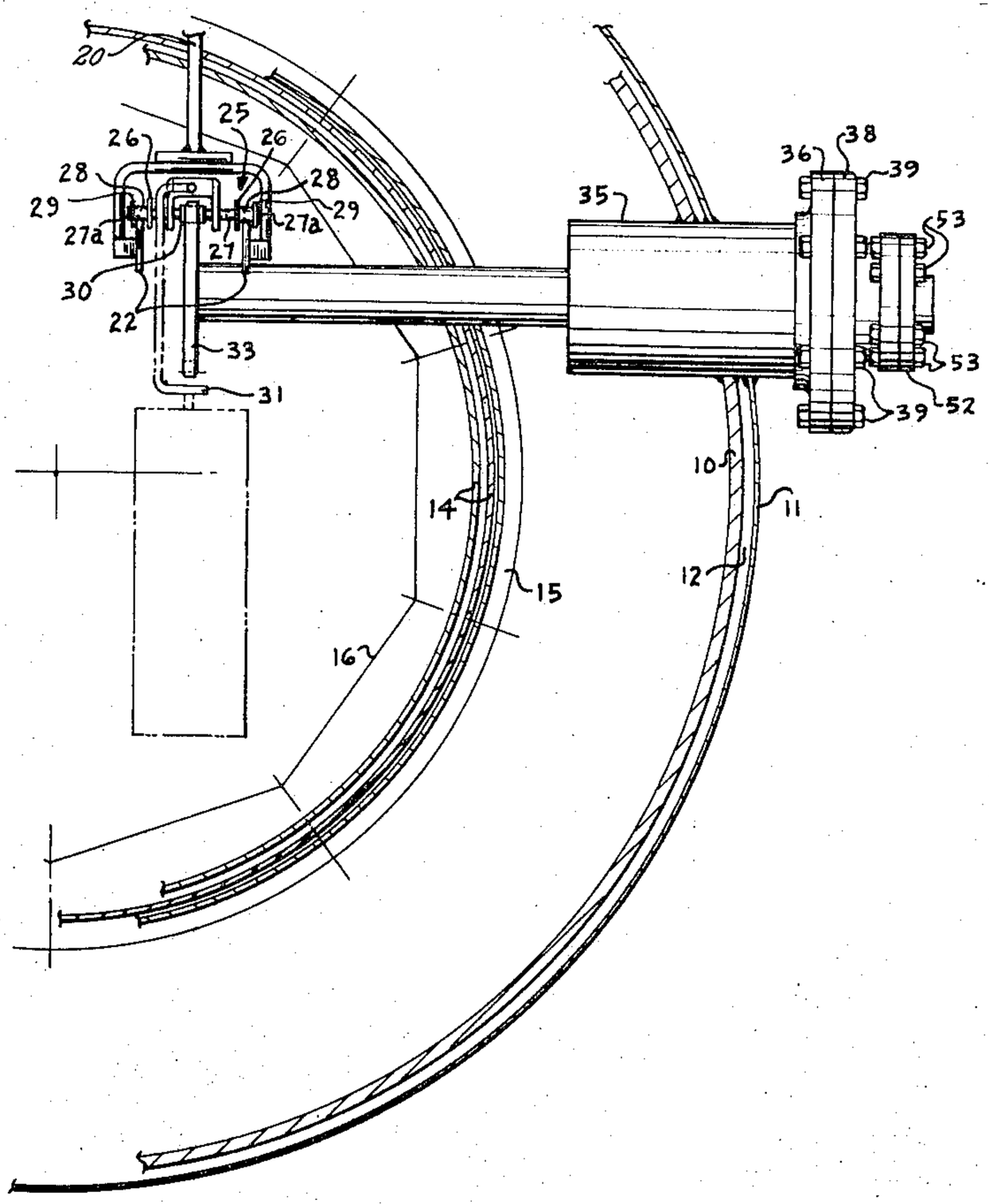

Fig. 1.

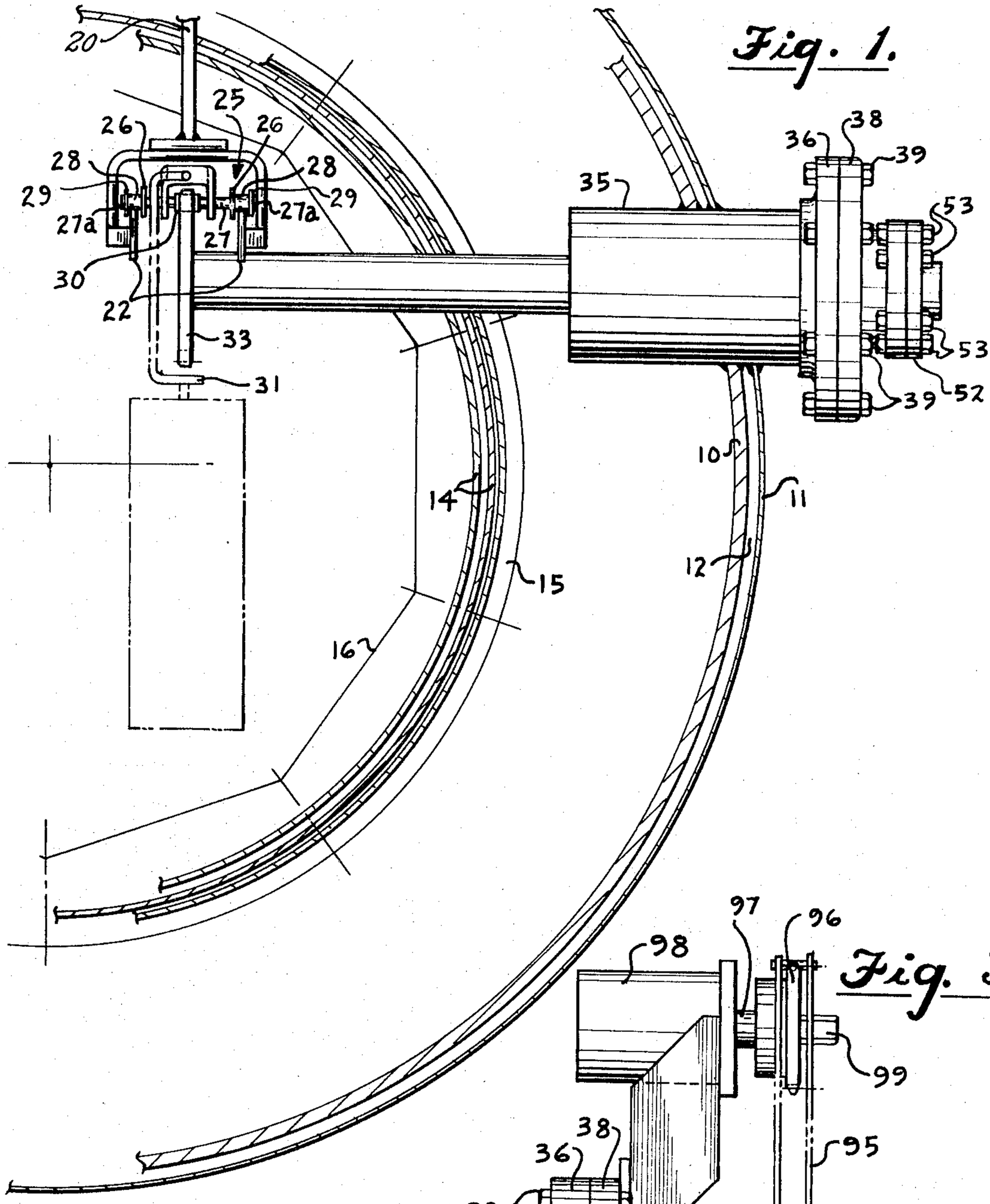
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Fig. 3.

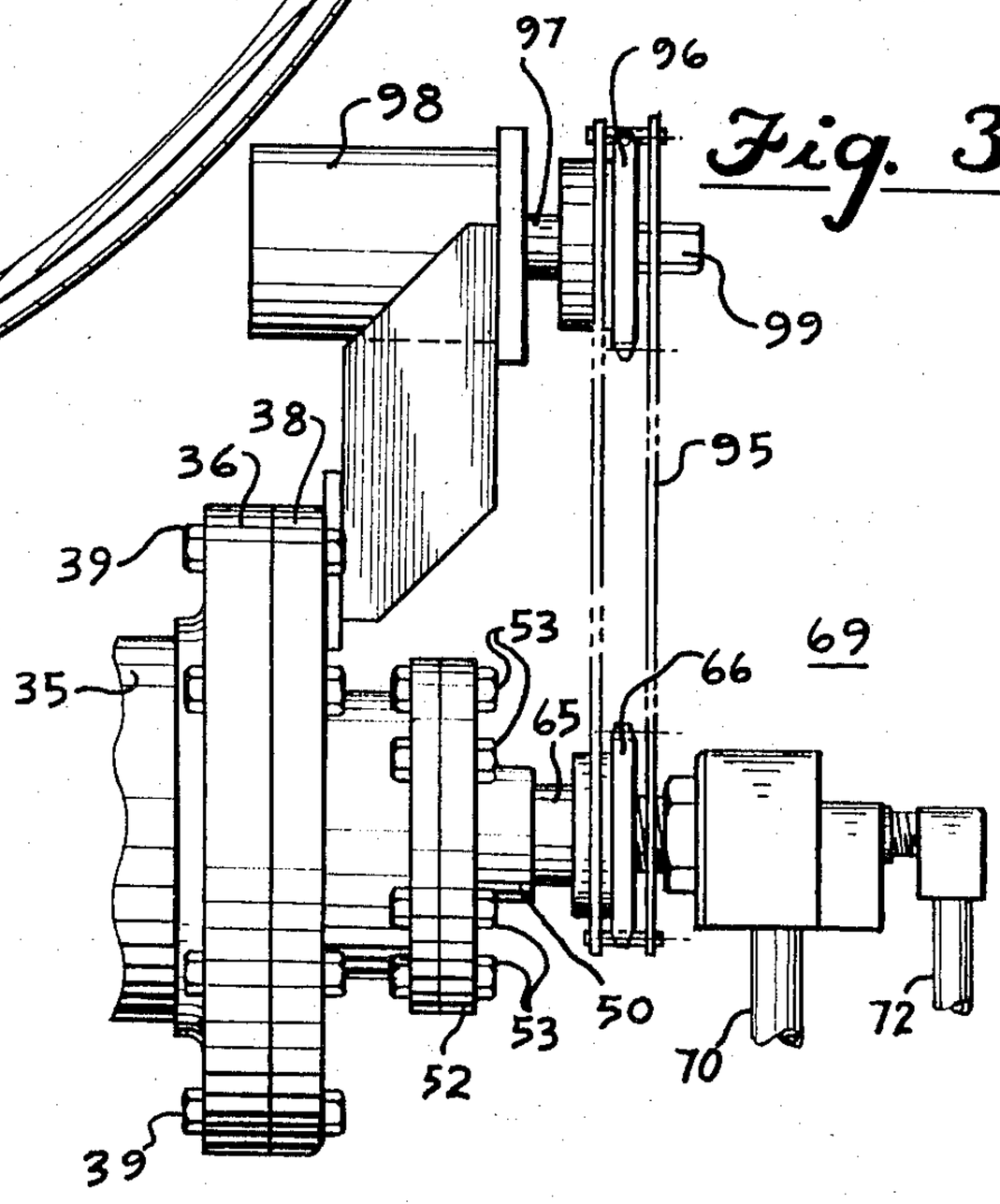
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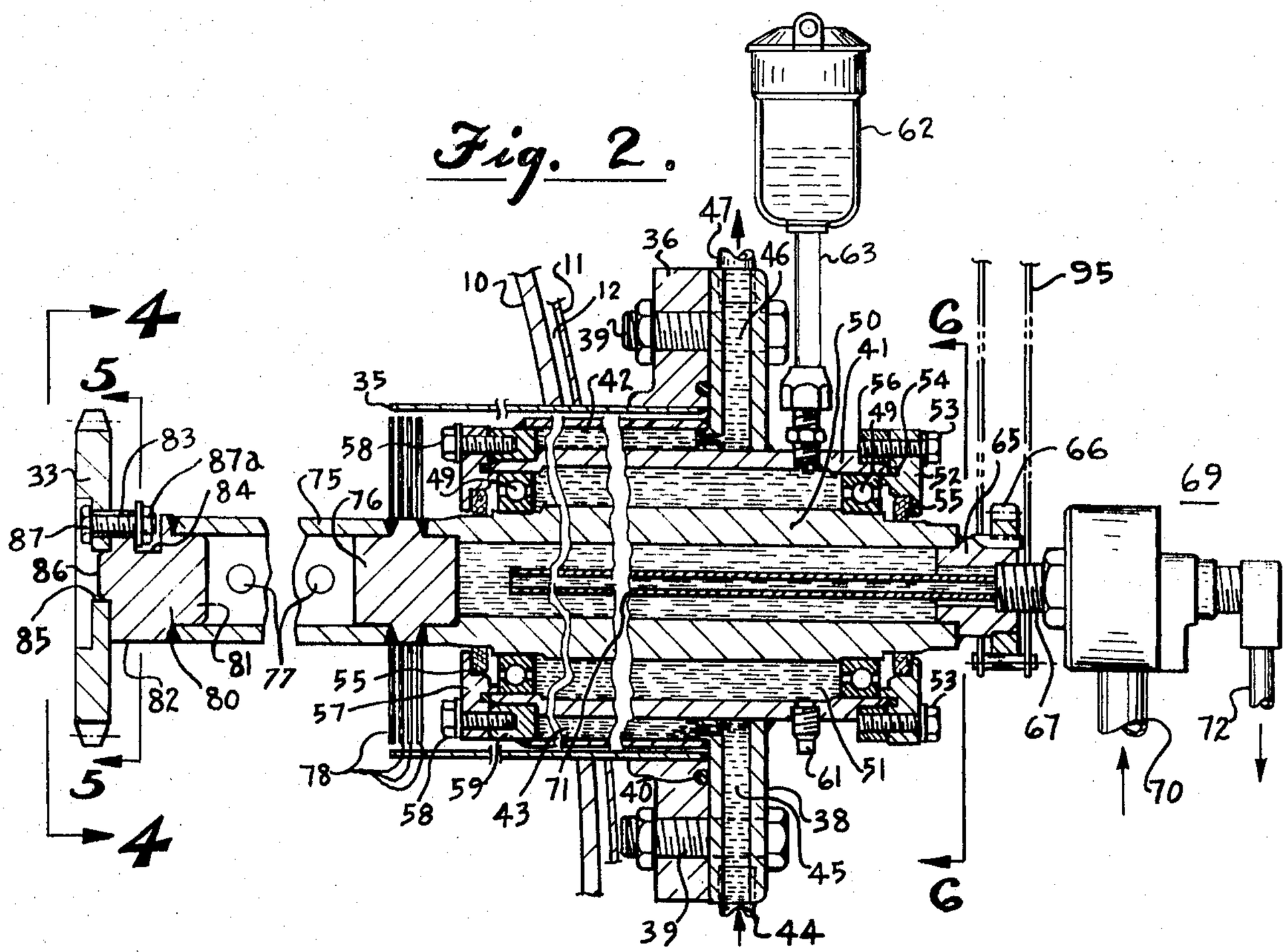
Fig. 2.



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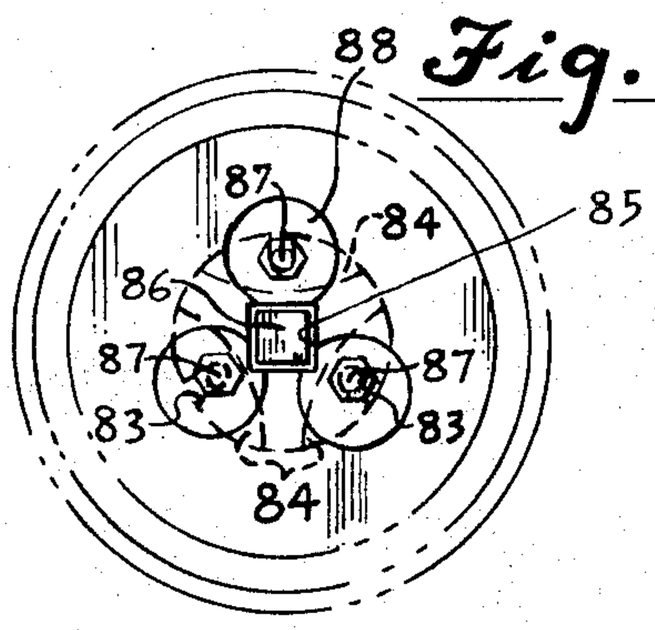

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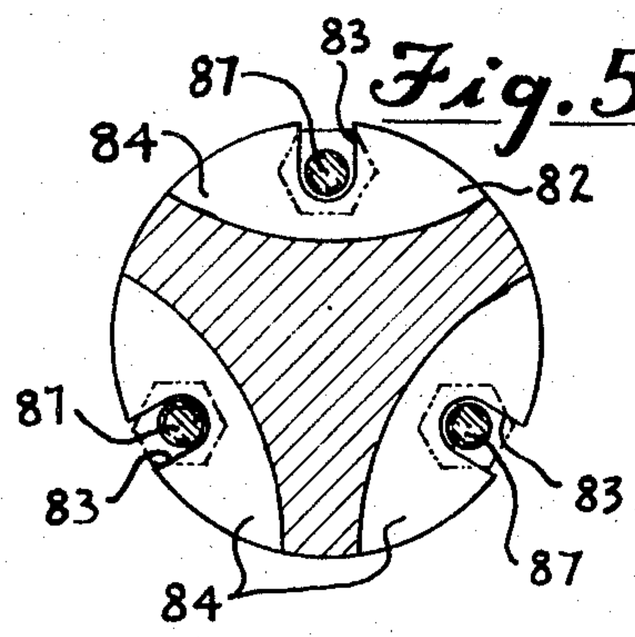
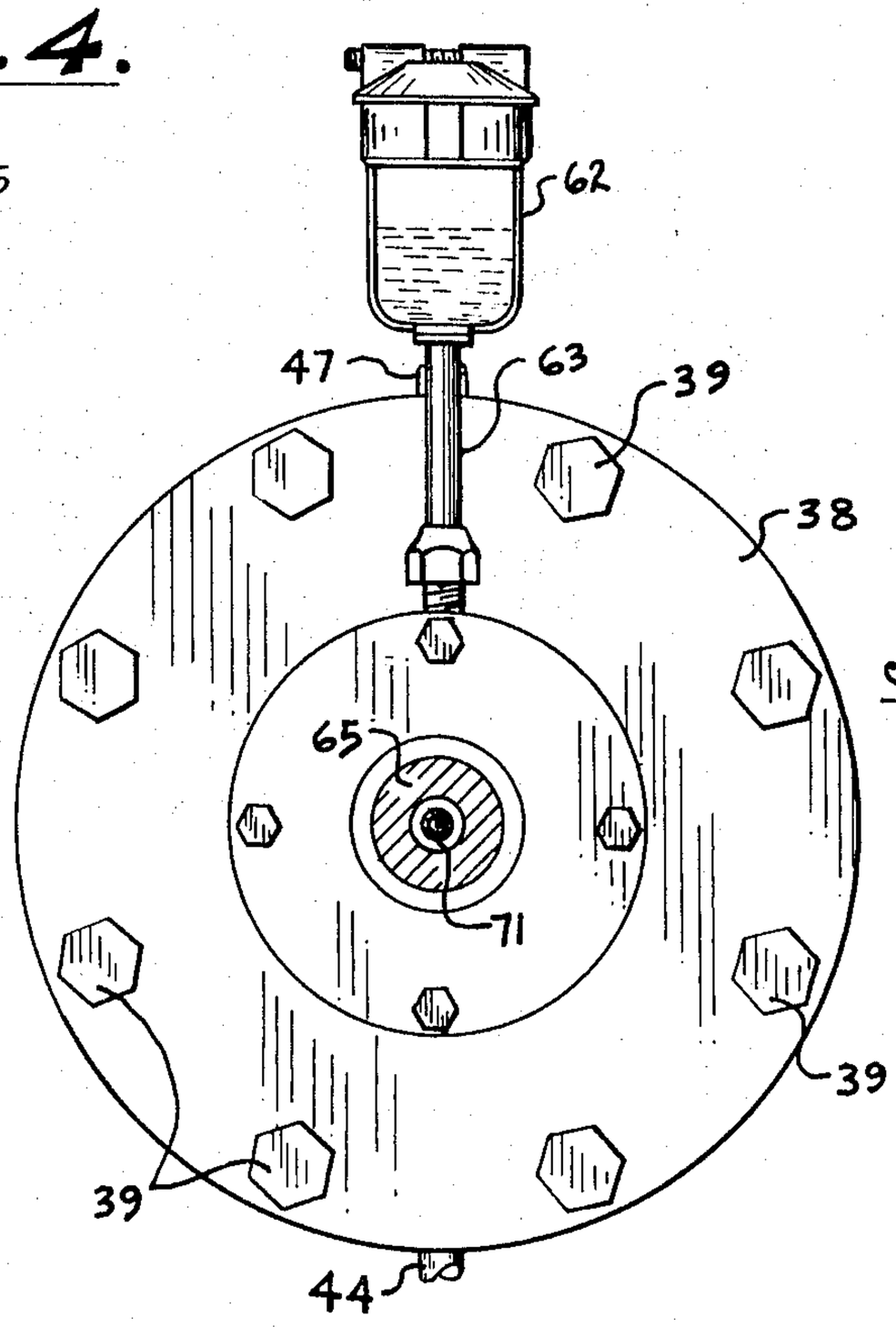


Fig. 6.



DRIVING MECHANISM FOR VACUUM ELECTRIC FURNACES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to driving mechanisms particularly adapted for use with vacuum electric furnaces.

2. Description of the Prior Art

Furnaces have heretofore been proposed in which the work pieces are advanced through a plurality of treating zones.

Various provisions have been made for advancing the work pieces, such as on wheeled trucks as in the U.S. Pats. to Kugel, No. 802,517, and Borner, Nos. 3,583,690 and 3,625,496, and Austin, et al., British Pat. No. 565,104.

It has also been proposed to employ endless chains to advance the work pieces as in the U.S. Pat. to Kochendorfer, No. 1,252,813, and to employ overhead trackways for movable elements such as in the U.S. Pats. to Miskella, No. 2,814,684, and Oetjen, et al., No. 3,192,645.

Bielefeldt, in U.S. Pat. No. 3,609,295 shows a vacuum electric furnace in which carriers of open rectangular frames are provided for the work pieces carried on a narrow bar having transverse horizontal axles with small rollers movable along interior tracks. The bars are driven by dogs on an endless chain within the vessel, the chains being driven by an exteriorly disposed motor.

Where the temperature gradient between the interior and exterior of the furnace is not great the provision of driving mechanism having portions extending through the furnace wall does not present great difficulties. The same is true where the interior vacuum is not high.

In vacuum furnaces, where the interior temperatures are of the order of 800° F. or higher, and the vacuum is of the order of 10^{-3} inches or less of mercury, serious problems arise. The interior temperatures are too high to permit of using driving motors inside the furnace. The provisions heretofore made for driving shafts extending through the furnace wall and driven by an external power source, have not proven satisfactory because of vacuum leakage, excessive heat leakage, early failure of parts exposed to high temperatures or for other reasons.

SUMMARY OF THE INVENTION

In accordance with the invention driving mechanism is provided, suitable particularly for vacuum electric furnaces, which functions satisfactorily over the temperature gradient between starting up and operation and with the temperature gradient between the interior and exterior of the furnace in operation, which is available as a cartridge type unit for quick replacement, in which the components subjected to high temperatures can be readily removed if desired, which has low heat conductivity between hot and cold locations, which has high heat conductivity of the portions at lower temperatures, in which seals are provided to prevent vacuum leakage and the seals are protected by cooling to increase their useful life, in which the interior parts subjected to vacuum can be readily evacuated, and which is normally motor driven but can be manually actuated, if desired.

It is the principal object of the invention to provide driving mechanism which is particularly suitable for advancing work pieces through a vacuum electric furnace.

It is a further object of the invention to provide driving mechanism as aforesaid which will have freedom from operating problems, a long useful life and which can be readily replaced, if desired.

Other objects and advantageous features of the invention will be apparent from the description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawings forming part hereof, in which:

FIG. **1** is a fragmentary vertical sectional view of a portion of the hot zone of a vacuum electric furnace having the driving mechanism of the invention mounted thereon;

FIG. **2** is an enlarged fragmentary vertical sectional view of the driving mechanism;

FIG. **3** is a fragmentary elevational view showing the exterior driving motor and the provisions for manual actuation;

FIG. **4** is an end elevational view taken from the location **4—4** of FIG. **2**;

FIG. **5** is a vertical sectional view, enlarged, taken approximately on the line **5—5** of FIG. **2**; and

FIG. **6** is a vertical sectional view taken approximately on the line **6—6** of FIG. **2.**

It should, of course, be understood that the description and drawings herein are illustrative merely and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, a fragmentary portion of the hot zone of a vacuum furnace is shown which includes a furnace tank wall **10** with a surrounding jacket wall **11,** the space **12** therebetween providing for cooling liquid circulation.

Within the interior of the tank wall **10,** and spaced inwardly therefrom, a plurality of spaced reflective shields **14** are shown, supported from a shield support ring **15** and which in turn support resistance heating elements **16** in strip or sheet form. The shields **14** and heating elements **16** can be of any desired type and if desired could be similar to those described in the application of Cyrway, et al., filed July 5, 1973, Ser. No. 376,538, now U.S. Pat. No. 3,812,276.

Supporting brackets **20,** secured to the tank wall **10** and extending through suitable openings in the shields **14** and heating elements **16** carry spaced elongated rails **22.**

Load carriers **25** are provided having spaced elongated side frame bars **26,** with spaced transverse rods **27** secured thereto. A selected number of the rods **27** can extend beyond the side frame bars, as at **27*a*** to carry track engaging rollers **28.** The rollers **28** ride on the tops of the rails **22** and are retained by outer flange bars **29** which aid in retaining the carriers **25** on the rails **22.**

The rods **27** between the frame bars **26** have rollers **30** which rollers **30** and their supporting rods **27** can be spaced at any desired locations but are preferably spaced to function as a rack for engagement by the teeth of a driving sprocket **33.**

The carriers **25,** at spaced locations, and preferably at their connections with other aligned carriers **25** can support pendant brackets **31** which carry the work pieces. The rails **22,** and their supports, and the carriers **25** can be of any desired type but advantageously can be as described in the application of Kreider, filed Apr. 22, 1974. Ser. No. 462,961.

The tank wall **10,** at desired locations, is preferably provided with a mounting cylinder **35** in fluid tight relation which has a mounting flange **36** carried thereon for detachably supporting the driving unit to be described.

The driving unit has a mounting flange **38** which is secured to the flange **36** in any desired manner, such as by bolts **39,** and with an interposed packing **40** to prevent fluid leakage at this location.

The mounting flange **38** has a cylindrical housing **41** fixedly secured thereto which is surrounded, in spaced relation, by a cylindrical jacket **42.** The space **43** between the housing **41** and jacket **42** provides for cooling fluid circulation and has a cooling liquid supply pipe **44** connected thereto by a passageway **45** in the flange **38** and a discharge passageway **46** in the flange **38** connected to a cooling liquid discharge pipe **47.**

The housing **41** has mounted therein, in spaced relation, a pair of shaft bearings **49** carrying the drive shaft **50,** a sealing and lubricating fluid space **51** being provided between the housing **41** and the shaft **50.**

The outer end of the space **51** is closed by an outer end closure plate **52** held in engagement with a closure ring **56** secured to the housing **51** by bolts **53.** A seal **54,** such as an O-ring, prevents fluid leakage at this location and a shaft seal **55** of conventional type, such as a garter spring oil seal is provided between the closure plate **52** and the shaft **50.**

The inner end of the space **51** is closed by an inner end closure plate **57** held in position by bolts **58** extending through the closure plate **57** and into a closure ring **59** engaged with the housing **41** and secured to the jacket **42** as by welding.

A packing **55** is interposed between the shaft **50** and the inner end closure plate **57** similar to the packing **55** previously referred to.

The space **51** has a drain plug **61** in the housing **41** and has a transparent supply receptacle **62** and a supply pipe **63** connected thereto for the supply of lubricating, sealing and heat transferring fluid and observation of the level of the fluid.

The shaft **50** has a hollow interior **51**a which extends inwardly beyond the inner bearing **49** and packing **55** and is closed at its outer end by a plug **65** which has mounted thereon and keyed thereto a pinion **66.**

The plug **65** has a rotatable nipple **67** in threaded engagement therewith.

A rotating joint or double purpose union **69,** of well known type, can be employed, which has a fixed cooling liquid supply pipe **70** for supplying liquid through the plug **65.** The union **69** has a non-rotating siphon pipe **71** extending into the interior of the shaft **50** for the return of cooling liquid therethrough and to a fixed discharge pipe **72.**

The shaft **50** is preferably of a material, such as carbon steel, having good heat conductive properties to aid in cooling.

The shaft **50** has a hollow tubular shaft extension **75** connected thereto by an interposed connector **76,** welded to the shaft **50** and shaft extension **75** by vacuum tight welds.

The shaft extension **75** can be of any desired material, but is preferably of a material, such as stainless steel, having relatively poor heat conductive properties and has a minimal cross section of adequate strength. This serves to reduce the amount of heat transmitted to the inner packing **52** and inner bearing **49** and reduces the burden on the cooling provisions for the shaft **50** and associated structure.

The interior of the shaft extension **75** is preferably in communication with the exterior through a plurality of openings **77** for rapid evacuation when the furnace chamber is evacuated.

The connector **76,** on the exterior thereof, has a plurality of shield discs **78** of reflective metal secured thereto for rotation therewith. The discs **78** substantially close the inner end of the mounting cylinder **35** against radiant energy transmission outwardly therethrough.

The shaft extension **75** is closed at its inner end by a sprocket connector **80,** has an end portion **81** extending into and secured to the shaft extension **75** and has a rim portion **82** with radial slots **83** open at their outer ends and with relief cut-outs **84** inwardly of each of the slots **83.**

The sprocket **33** preferably has a central rectangular opening **85** for engagement on a square shaft end portion **86** on the sprocket connector **80.** The sprocket **33** is held in position by bolts **87** carrying nuts **87***a*, the heads of bolts **87** being in counterbores **88** and the shanks engaged in the radial slots **83.** The engagement of the bolts **87** in this manner permits of shearing of the bolts **87** for replacement in the event of undesired seizure, the radial slots permitting fall out or easy removal.

The pinion **66** preferably has a sprocket chain **95** engaged therewith, the chain **95** being carried on a sprocket **96** on a shaft **97** normally driven by a motor **98** on the exterior of the wall **10** of the furnace tank. The outer end of the shaft **97** is preferably hexagonal, as at **99,** for the reception of a wrench (not shown) for turning the shaft **97** and through the sprocket **96,** chain **95** and pinion **66** to manually operate the shaft **66** if the motor **98** is for any reason out of action.

The mode of operation will now be pointed out.

In operation the temperature in the interior of the furnace may be of the order of 1,200° F. with starting up and exterior temperatures at normal atmospheric levels. The increase of temperature within the furnace brings about a change of dimensions or growth within the interior of the furnace which must be taken into account and which is accommodated with the structure herein described.

When it is desired to rotate the shaft **50** and the shaft extension **75** for driving action by the sprocket **33,** the motor **98** is activated to rotate the shaft **97,** to drive the sprocket **96,** chain **95** and pinion **66,** which rotates the shaft **50.** For normal furnace operation the shaft **50** may run at about 20 r.p.m. to advance the work pieces at the desired rate. The structure disclosed is not how-

ever limited to slow speed rotation and could operate at 2,500 r.p.m. and higher, if desired.

Heat transfer from the furnace interior is inhibited by the shield discs **78** as well as by the material of which the shaft extension **75** is made.

The shaft bearings **49** are lubricated and cooled by the use of the liquid in the space **51** which is supplied from the supply receptacle **62.** The adequacy of the supply can be visually checked. The liquid in the space **51** also enhances the sealing action of the seals **55** since for a leak to occur it would have to pass the outer seal **55,** the main body of liquid in the space **51** and the inner seal **55.** This liquid also serves as a heat transfer agent to the outer and inner cooling fluids.

The exterior of the housing **41** is cooled by the cooling liquid supplied at the supply connection **44** and passing through the space **43** for discharge through the discharge connection **47.**

The cooling fluid supplied through the supply pipe **70** through the coupling or union **69** to the interior of the shaft **50** is effective for cooling the seals **55,** and the bearings **49,** and particularly the inner seal **55** and bearing **49,** the siphon pipe **71** delivering the liquid to the discharge pipe **72.**

Upon evacuation of the interior of the furnace tank within the wall **10** the openings **77** are effective for evacuation of the interior of the shaft extension **75** thereby avoiding slow contamination of the interior of the furnace which might occur if free evacuation were not available.

Manual operation of the shaft **50** can also be effected if desired as heretofore pointed out.

We claim:

1. Driving mechanism for use with a vessel having the interior and exterior subject to temperature and pressure differentials comprising

a fixedly mounted housing facing the interior of the vessel,

a shaft journaled within said housing in spaced relation thereto for rotation with respect to said housing, and

liquid sealing means interposed between said shaft and said housing for preventing fluid leakage between the interior and the exterior of the vessel and comprising

sealing members spaced along said shaft in sealing relation thereto, and

a liquid supply connection communicating with the space between said shaft and said housing for supplying lubricating and sealing liquid between said sealing members.

2. Driving mechanisms as defined in claim **1** in which

members are provided for supplying cooling fluid in cooling relation to said shaft and for removal of said cooling fluid.

3. Driving mechanism as defined in claim **1** in which

said shaft has a hollow interior portion, and

members are provided for supplying cooling fluid to the interior portion of said shaft and for removal of said cooling fluid.

4. Driving mechanism as defined in claim **1** in which

said shaft has an extension portion within the vessel, and

said extension portion is of a material of lesser heat conductivity than the portion of said shaft contiguous to the vessel wall.

5. Driving mechanism as defined in claim **1** in which

said shaft has an extension portion within the vessel, and

said extension portion is of reduced cross section for minimizing heat conduction therealong.

6. Driving mechanism as defined in claim **1** in which

said shaft has a hollow tubular extension within said vessel, and

vents are provided communicating with the interior of said hollow tubular extension for evacuation thereof.

7. Driving mechanism as defined in claim **6** in which

said tubular extension is closed at its inner end by a connector, and

said connector has a polygonal end portion for the reception of a driven member.

8. Driving mechanism as defined in claim **7** in which

said driven member is a sprocket with a central opening complemental to said polygonal end portion.

9. Driving mechanism as defined in claim **8** in which

said connector has radial open ended slots, and

attaching members for said sprocket are provided comprising bolts engaging said sprocket and extending in intersecting relation to said slots.

10. Driving mechanism as defined in claim **2** in which

said housing has a jacket in spaced surrounding relation thereto, and

said last mentioned members include fluid connections for supplying cooling fluid between said housing and said jacket.

11. Driving mechanism as defined in claim **3** in which

said hollow portion of said shaft extends inwardly contiguous to at least one of said sealing members for cooling said sealing member.

12. Driving mechanism as defined in claim **1** in which

operating means is provided for rotating said shaft including a motor connected in driving relation to said shaft, and

said operating means includes a manually accessible portion for manual operation of said shaft independent of said motor.

13. Driving mechanism as defined in claim **10** in which

said shaft has a hollow interior portion, and

sail last mentioned members include fluid connections for supplying cooling fluid to the interior portion of said shaft.

14. Driving mechanism as defined in claim **1** in which

the wall of said vessel is provided with a mounting member the interior of which is in communication with the interior of the vessel,

said housing is detachably connected to said mounting member, and

said shaft has heat shielding members carried thereon for blocking access of radiant heat to the interior of said mounting member.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,847,539 Dated November 12, 1974

Inventor(s) Benjamin A. Kreider, William J. Metalsky

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, the name of the second inventor should appear as - William J. Metalsky - .

Signed and sealed this 7th day of January 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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