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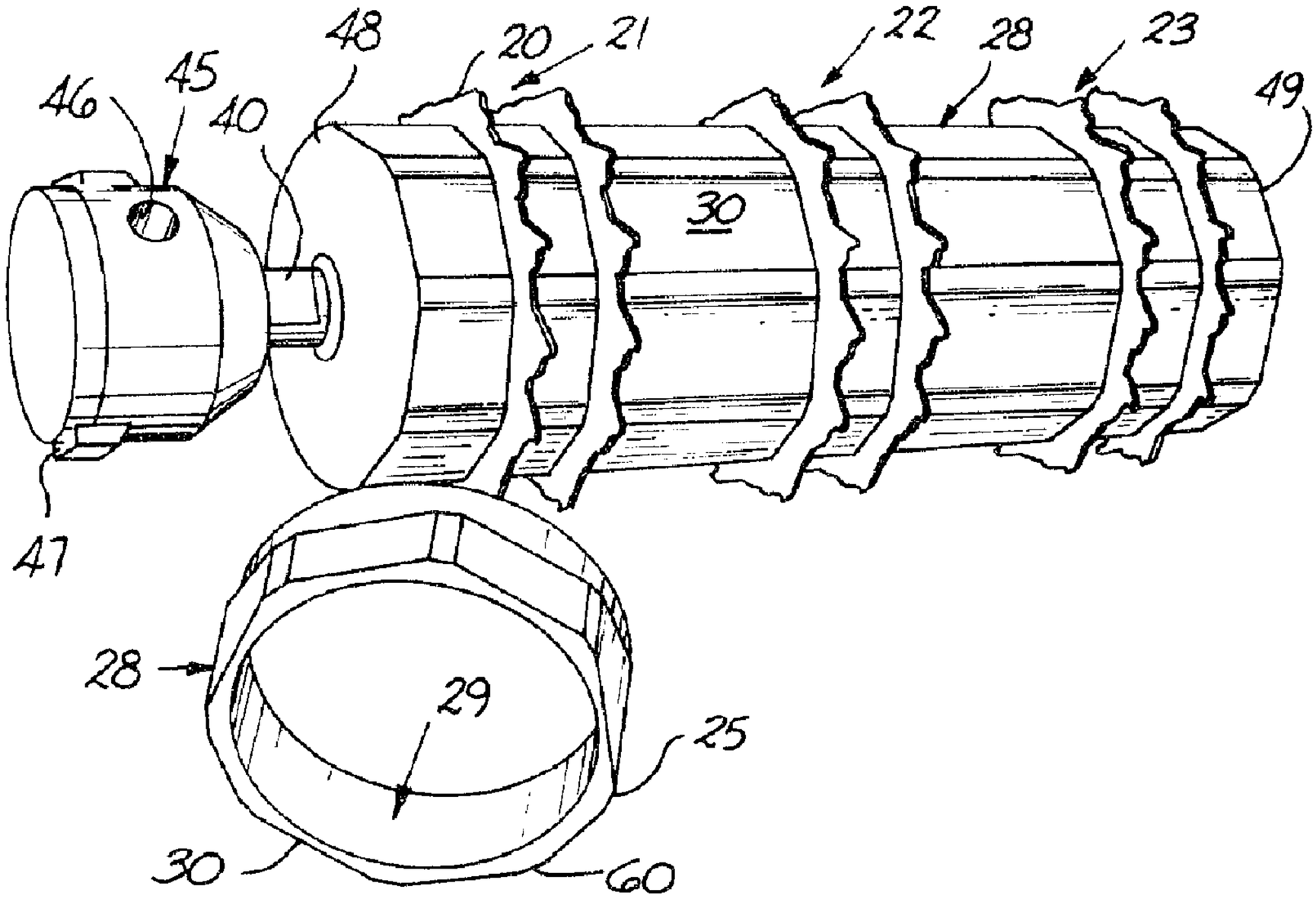
(54) Title: MODULAR CONVEYOR BELT SEALED SPROCKET DRIVE SYSTEM



(57) Abrégé/Abstract:
Self contained modular powered sprocket drive units for modular link conveyor belt drive systems are disposable across the belt width to mate laminar sprocket ring drive teeth into corresponding mating belt drive surfaces. These modular units may be located along the belt at one or more positions, and are easily removable for maintenance or replacement. A set of sprocket rings are mountable axially in locations that match different belt drive requirements. Provision is made to fix one sprocket drive lamination in place for belt tracking purposes with other sprocket drive laminations floating axially on the drive shaft for dynamic conformation to dimensional changes in the modular link belt when driven. The drive shaft is hollow and contains an electric motor and gear drive train, thus permitting the modular drive unit to be no longer than the width of the driven belt.

BSTRACT OF THE DISCLOSURE:

Self contained modular powered sprocket drive units for modular link conveyor belt drive systems are disposable across the belt width to mate laminar sprocket ring drive teeth into corresponding mating belt drive surfaces. These modular units may be located along the belt at one or more positions, and are easily removable for maintenance or replacement. A set of sprocket rings are mountable axially in locations that match different belt drive requirements. Provision is made to fix one sprocket drive lamination in place for belt tracking purposes with other sprocket drive laminations floating axially on the drive shaft for dynamic conformation to dimensional changes in the modular link belt when driven. The drive shaft is hollow and contains an electric motor and gear drive train, thus permitting the modular drive unit to be no longer than the width of the driven belt.

MODULAR CONVEYOR BELT SEALED SPROCKET DRIVE SYSTEM

This invention relates to modular link conveyor belt systems and more particularly it relates to sprocket drive mechanisms therefor.

Plastic modular link conveyor belts are ideally suited for processing foods, chemicals and other critical products that must be protected from environmental contamination, such as bacteria, oil or accumulated dust, dirt and grime. In such environments the belt and belt drive systems need to be sanitized or cleaned frequently, and this is difficult and possibly dangerous when the drive system is located inaccessibly. Also, conventional drive systems using sprocket teeth often employ rough surfaces, crevices and corners tending to accumulate contaminants. In such environmental operating conditions, it has been difficult with prior art systems to meet the critical requirements for cleanliness and sanitation because of the presence of sprocket drive teeth and accompanying drive mechanisms in modular link belt drive systems. Consider that because of the mechanical requirements to bear loads and to rotate for long times sprocket gear teeth and accompanying drive mechanisms require lubrication,

which encourages vapors and grime inconsistent with sanitation and lack of contamination. Thus, it is a significant problem when contaminants are present, even in trace quantities and where sprockets and drive systems take configurations that tend to breed pockets of contaminants and which are very difficult to reach and clean.

Furthermore sprocket drive systems often employ mechanisms which are subject to excessive wear in the environment of modular link belt operations, where abrasive residue from the belt can significantly shorten operating life.

Additionally safety to operating and service personnel is a problem. However, conventional prior art sprocket drive mechanisms for conveyor belts have drive gears, pulleys and like mechanisms which may not be adequately protected from the possibility of encounter with clothing, tools, loads or even personal body parts such as hands which can be damaged or eyes into which damaging materials could be thrown.

Sprocket drive systems having multiple sprockets across the width of a belt that are rigidly spaced tend to interfere with a modular conveyor belt under conditions of stress, curves and changes of dimensions in mating belt drive socket configurations because of loading or temperature changes. Also as a matter of quality control, it may be difficult to keep modular conveyor belt configurations within very exacting dimensional tolerances that fit fixed sprocket drive wheel spacings. As emphasized when metal drive sprockets engage plastic belt modules, the undesired

friction and loading is accompanied by belt wear that significantly reduces belt life.

Furthermore, the location of belt drive sprockets in belt drive systems may not be optimal because of the power drive trains that heretofore have not been compact to fit in various limited space positions. Also it is desirable for optimal system performance to distribute drive power to various belt locations, particularly with longer belts, and the inconvenience of coordinating power drive systems for this purpose has led to compromise in system performance and operating life. Nor have the power drive systems been accessible for maintenance and replacement of defective or worn sprocket wheels and the like, thereby introducing complexity and labor cost for disassembly of portions of the conveyor system to service the power drive portion.

It is therefore an objective of this invention to provide improved sprocket drive systems in modular conveyor belt systems.

Another object of the invention is to provide sprocket drive systems with longer operating life.

Still another object is to provide sprocket drive systems with improved safety to operating and service personnel.

Further it is an object of the invention to produce sprocket to belt drive configurations that are less susceptible to

nterference when encountering stress and dimensional variations in the conveyor belts.

Another objective of the invention is to provide compact modular drive units that are substantially universally positionable along a conveyor belt system, and adaptable to different belt design and drive sprocket configurations.

Other objects, features and objectives of the invention will be found throughout the following description, drawings and claims.

Substantially all the operating hazards dangerous to personnel are eliminated from the belt drive mechanisms as well as the propensity to accumulate or spread contaminants such as bacteria grease or grime. Thus by closing and sealing in the sprocket drive system mechanism, a conveyor belt system is made more acceptable for environmental control in processing food or chemical products.

Also, operating conditions are improved by compactness of the drive mechanisms into a modular element in accordance with this invention. This reduces friction and packing space, and expedites servicing with simple modular replacement of drive mechanisms with compact modules.

The drive modules are made substantially universal in character by accommodation of various belt sprocket configurations with easily accessible and replaceable sprocket discs. The discs are light weight, thereby reducing power and

nertia for better operating conditions, yet sturdy and strong in their assigned duty of driving loaded belts. The discs are further capable of accommodating dynamic stresses of loaded belts under various environmental conditions including curved paths, radical temperature changes and unbalanced loading, by means of free lateral movement transverse to the belt if desired.

All these advantages are achieved by mounting sprocket teeth upon a hollow rotating member internally housing the driving mechanism, typically a substantially cylindrical hermetically sealed drum, which is typically driven by an internally disposed electric motor and drive gear train. The drum when hermetically sealed prevents leakage of oil, vapor or worn off residue into the atmosphere. Likewise it eliminates dirt, dust and abrasives from the drive mechanism thus providing longer life expectations.

Furthermore, this invention by means of electric drive means coaxially coupled to the shaft provides a modular self contained sprocket wheel power drive unit that can be removably disposed across the width of a modular link conveyor belt at various places in a conveyor belt system. This self contained unit is positionable as a module at one or more predetermined locations within the conveyor belt system for ready removal. This feature permits modular system design with location of modular drive units throughout a system, as is particularly advantageous for longer belts and plastic belts where a single laminar metal drive sprocket system may unduly stress modular plastic belt links. Also the modules are significantly advantageous for maintenance

and repair, permitting simplified removal for substitution of other modules with very little down time, and/or permitting facilitated repair or maintenance procedures after removal from restricted locations in the belt drive system.

The sprocket teeth are preferably formed on light weight hollow disc like rings mated on the outer rotating drum peripheral surface of the driving module and keyed for rotation with the drum. Shaped drum surfaces, preferably octagonally sculptured, advantageously drive and key the rings for location along the drum axis to mesh with belt drive apertures individually or in sets. Discs are readily provided and positioned to conform to the sprocket drive spacings and teeth configurations for a variety of different belts. The sprocket rings are mountable with at least a degree of free axial movement to accommodate dynamic belt conditions encountered from unbalanced loading, movement around curves and significant temperature changes, thereby increasing belt life and reliability.

In one embodiment, a multiplicity of floating sprocket wheels that conform with changes in belt dimensions across the belt width are rigidly registered with the center of the belt by means of an easily replaceable sprocket wheel retained in a groove at the center of a drive shaft upon which the sprocket wheels are mounted.

Other features and advantages will be evident from the following text.

In the accompanying drawings, wherein like features are given similar reference characters in the several views to facilitate comparison:

Figure 1 is a fragmental side view sketch of a modular link conveyor belt sprocket drive system wherein the belt is conveyed by sprocket teeth in the direction of the arrow,

Figure 2 is a side perspective view of a modular belt sprocket drive mechanism embodiment of the invention, with comparative fragmental cutaway segment emphasizing construction details of the hollow outer drum used in accordance with this invention to carry the sprocket teeth,

Figure 3 is a perspective, cut away sketch of a typical motor drive embodiment afforded by this invention,

Figures 4, 5 and 6 are sketches, partly in section, and partly broken away, looking axially into the drive shaft for different sprocket wheel to shaft coupling configurations which permit the sprocket wheels to move axially along the shaft in a belt driving relationship,

Figure 7 is a sketch of a drive shaft embodiment with a circumferential groove for retaining a sprocket wheel in a fixed axial position along the shaft, and

Figures 8 and 9 are respective perspective and end views of an assembly of sprocket drive wheels that axially adjust to lateral belt dimensional changes while restraining the belt from drifting in axial position.

With respect to Figure 1, it is seen that modular link conveyor belt 15 is driven toward the right by means of sprocket teeth 16 in the rotatable sprocket wheel 17, which may be in the form of a drum, disc or series of spaced discs. This sprocket wheel 17 is keyed on a drive shaft by a non-circular and preferably symmetrical central bore 19, in this embodiment defined as an octagon with flat planar sides 18.

As seen in Figure 2, a series of sprocket discs 20 are arranged in paired sets 21, 22, 23 axially along the outer peripheral surface 25 of a hollow body member 28 in the form of a substantially cylindrical pipe 29 with a smooth cylindrical interior surface in this embodiment. The outer peripheral surface has eight flattened surfaces 30 arranged in octagon configuration for mating with octagon shaped aperture surfaces 18 of the individual sprocket discs 20.

The discs 20 and disc sets 21, etc. may have sprocket tooth shapes and spacings to mate with various modular belt configurations of various widths. The outer hollow body member 28 as shown in both Figures 2 and 3 is rotatable coaxially about a supporting shaft 40, which is anchored to a suitable frame, thus

making the externally disposed stationary service compartment 45 accessible for receiving lubricating fluid at port 46 and electrical connections at terminals 47. The hollow member 28 has end plates 48, 49 to form an enclosed drum assembly capable of hermetic sealing to prevent dust and grime or conveyor belt residue from entering into the interior, and for preventing internal grease, grit or vapors from entering the environment in which the conveyor belt is working.

In the drum interior 50, as shown in Figure 3, is mounted the conveyor belt electrical drive motor 51, coaxially coupled with driveshaft 30. Conventional stator member 52 is mounted on the stationary inner wall 56 and the conventional armature 53 mounted on the rotatable shaft 54 along the axis of the drive shaft 30, and is journalled for rotation in bearing 55. Thus, the motor drives the planetary gear train 57 having individual gears journalled in bearings 58, etc. thereby to rotate the drum end panel 49 and thus the outer hollow drum cylindrical member 28. Variations from this particular electrical motor driven mechanism can be made without departing from this invention. Alternative forms of such mechanisms are known in the art, such as shown in Chung patent 4,082,180, April 4, 1978 and Besel, et al. patent 3,064,797, Nov. 20, 1962. Also, more than eight sides, say 20 are possible, especially for large diameter sprockets.

Although fewer drum sides 30 could be used, the octagonal configuration including the rounded corners 60 has significant

advantage in that the peak to valley ratio of wall thickness is reduced and a thinner, lighter shell is rotatable with less energy. The even number of surfaces is thus symmetrically disposed for good balance. However, if it is desirable to radially key the sprocket discs 20 in a particular position, one such surface (18, 30) may be made asymmetrical by being shorter, longer, or shallower, etc. The thin walls also provide a better dissipation of internal heat from the drive mechanism, which can also be aided by internal lubricant-cooling fluids supplied and monitored at the port 46.

It is evident that the mechanism is easily cleaned and sanitized in the absence of any rough surfaces, crevices and corners that tend to accumulate dirt, grease or grime. The sprocket discs, particularly when freely axially movable can also be easily moved or removed from the drum for cleansing and sanitation. A preferable drum surface material would be anodized aluminum, since it is light weight and non-corrosive, or stainless.

As seen in the respective shaft to sprocket wheel embodiments of Figures 4, 5 and 6, the drive key 62 configuration for non-rotatively retaining the sprocket wheel 24 on the shaft 30 while permitting axial movement may have different patterns. The sprocket wheel 24 is a laminar ring member in contact with the outer surface of hollow drive shaft 30. Mating keying structure respectively provided on the rotatable shaft 30 and

sprocket wheels 24 assures rotation of sprocket wheels in a driving relationship with a modular link belt conveyor system. The keying structure constitutes axial displacement means for permitting at least a subcombination of the sprocket wheels aligned on the shaft to axially move along the shaft in response to dynamic conditions encountered in driving the belt.

The special shaft configuration 30C as shown in Figure 7 has an additional feature in that a circumferential groove 66 is provided along the shaft. This, as later explained, is for anchoring the belt drive axis at a predetermined axial location on the shaft 30, to assure proper tracking of the belt so that the belt cannot wander axially off track, even though sprocket wheels 24 are permitted to move axially on the shaft.

By reference to Figures 7 and 8, it is seen that if the sprocket wheel 67 is slipped in registration over a keyed shaft, in Figure 8 of hexagonal configuration, when it reaches the indentation groove 66, it may be rotated without registering the respective key structure on the wheel and shaft, in effect disregistering the shaft and sprocket wheel keys. Thus the sprocket wheel is retained axially in place, when not rotated back into a position to put the shaft and sprocket wheel keys in registry.

In Figures 8 and 9 consider that sprocket wheel 24C is on the shaft with keys in registry and sprocket wheel 67 is rotated in the indentation so that the keys are misaligned and the wheel 67 is axially retained. The indentation may be wide enough to

permit a desired degree of axial movement, if desired, but serves the purpose of confining axial mobility of sprocket wheel 67. In Figure 9, the segments 68 of sprocket wheel 67 are shaded to emphasize the rotational mis-alignment of the keys. The offset angle of the keys in sprocket wheels 24C and 67 is preferably 22.5 degrees when an octagonal shaft surface key is employed. Note that the sprocket wheels 24C and 67 are not identical because the apertures 70, 71 are offset differently relative to the key configurations in the respective wheels.

A coupling yoke member, such as rod 68 (preferably with at least one other, not shown), is coupled between sprocket wheels 24C and 67 at the respective apertures 70, 71 to prevent rotation of sprocket wheel 67 while it is retained in its axially locked in posture, since sprocket wheel 24C is non-rotationally keyed to the shaft (60). The particular sprocket wheel 24C may be held in an axially fixed relationship by the coupling member 68, or alternatively may axially slide along it to float. Any other sprocket wheels are free to float and need not ride on the coupling member 68.

Having therefore advanced the state of the art with improved sprocket drive systems for modular conveyor belts, and self contained sprocket drive modules those novel features setting forth the spirit and nature of the invention are defined with particularity in the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A modular conveyor belt system comprising:

a conveyor belt having modular belt links driven by sprocket teeth;

a rotary drum;

an electric sprocket drive motor disposed within the rotary drum with a mechanism for rotating the rotary drum with the motor, the motor and the mechanism being sealed in the rotary drum for protecting the belt system from contaminants;

and a sprocket tooth assembly removably keyed by means of mating non-round surfaces on the rotary drum and the sprocket tooth assembly for rotation therewith to engage and drive the conveyor belt.

2. The belt system of claim 1 wherein the sprocket tooth assembly comprises at least one substantially circular collar member carrying sprocket teeth and wherein the rotatary drum has a substantially cylindrical outer surface modified to define a configuration for keying thereon to rotate with the rotary drum the at least one substantially circular collar member.

3. The belt system of claim 2 wherein the circular collar members comprise discs adapted to freely move at least a limited distance axially along the drum surface to follow dynamic position changes encountered in the belt under operating conditions.

4. The belt system of claim 2 wherein the configuration comprises a multiplicity of substantially planar surfaces axially disposed along the substantially cylindrical outer surface.

5. The belt system of claim 4 wherein the configuration has an even number of said planar surfaces.

6. The belt system of claim 5 with one of the planar surfaces configured asymmetrically with the other planar surfaces to produce keying structure for orienting the sprocket discs in a particular radial position.

7. The belt system of claim 4 with eight said planar surfaces.

8. In an endless conveyor belt system, the combination comprising:

a modular link belt having drive apertures periodically presented;

rotatable sprocket drive means presenting sprocket drive teeth in mating registration with said apertures to drive the belt, further comprising:

a rotatably mounted hollow drum configured to retain sprocket tooth carrying means thereon positionable axially at various positions along the drum and keyed by mating non-round surfaces on the drum and tooth carrying means;

a drive motor mounted internally in said hollow drum; and

drum rotating means for rotating said drum with said motor to drive said belt in response to energization of said motor, said drive motor and said drum rotating means being sealed inside said hollow drum.

9. The system of claim 8 further comprising a multilaterally surfaced outer drum periphery, and wherein the sprocket tooth carrying means includes a plurality of sprocket tooth rings mating with said periphery in axially spaced relationships axially along the drum.

10. The system of claim 9 further comprising means permitting the rings to freely move at least a limited distance axially along the drum when engaged to drive said belt thereby to conform with dynamic lateral belt movements across the drum in the presence of loading and temperature forces.

11. A driver mechanism for a modular link conveyor belt, comprising in combination:

a hollow member disposed along an axis for disposal transversely across said belt in a driving relationship with the belt;

a driving motor confined within said hollow member;

a shaft engaging, supporting and extending from said hollow member for supporting the member along-side the conveyor belt;

driving means coupling the motor to the hollow member for rotation about said shaft;

means for sealing the hollow member into a body isolating the motor and gearing from the environment, thereby to prevent residue from operation of the motor and gearing from leaving the body during belt operation;

a tooth assembly surrounding the hollow member; and

keying means constituting mating non-round surface configurations on the hollow member and tooth assembly for rotating sprocket drive teeth by means of the hollow member to drive said belt.

12. The mechanism of claim 11 wherein the tooth assembly further comprises a plurality of sprocket rings dispersed axially along the hollow member.

13. The mechanism of claim 12 wherein the hollow member is configured to have an outer peripheral surface of a predetermined multilateral shape, and said sprocket rings have a central aperture of corresponding multilateral shape for mating on the hollow member in a belt driving relationship.

14. The mechanism of claim 11 wherein the hollow member further comprises a generally cylindrical member with a plurality of axially oriented substantially planar surfaces disposed about an outer periphery of the hollow member.

15. The mechanism of claim 14 wherein the periphery of said member is substantially octagonal in shape.

16. The mechanism of claim 14 wherein the plurality of planar surfaces is even numbered.

17. The mechanism of claim 16 wherein the tooth assembly comprises at least one ring member movable axially along the outer periphery of the hollow member, and wherein one of said plurality of planar surfaces is asymmetrically configured to provide keying means for orienting the at least one ring member into a keyed relationship with the hollow member.

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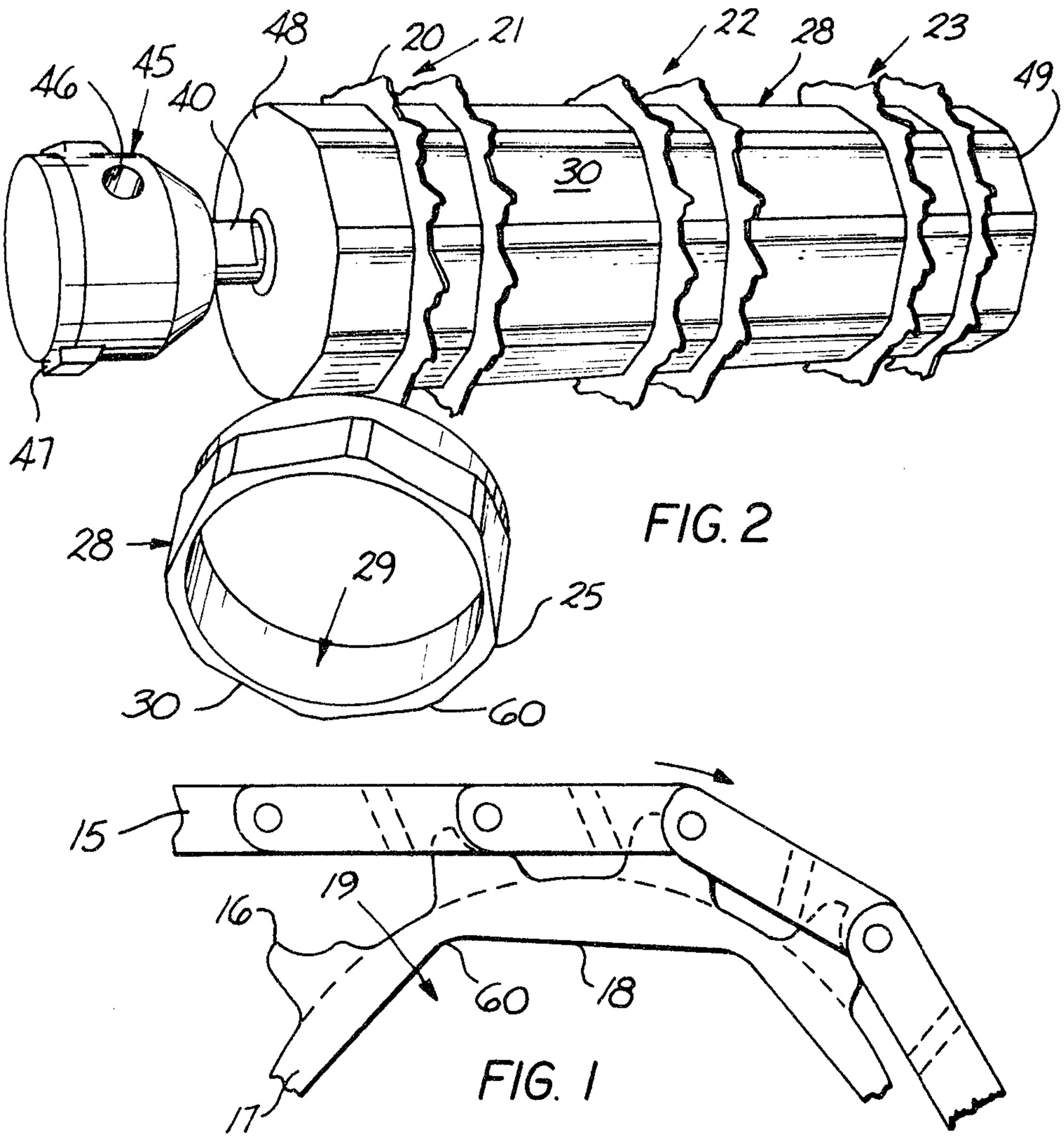

FIG. 2

FIG. 1

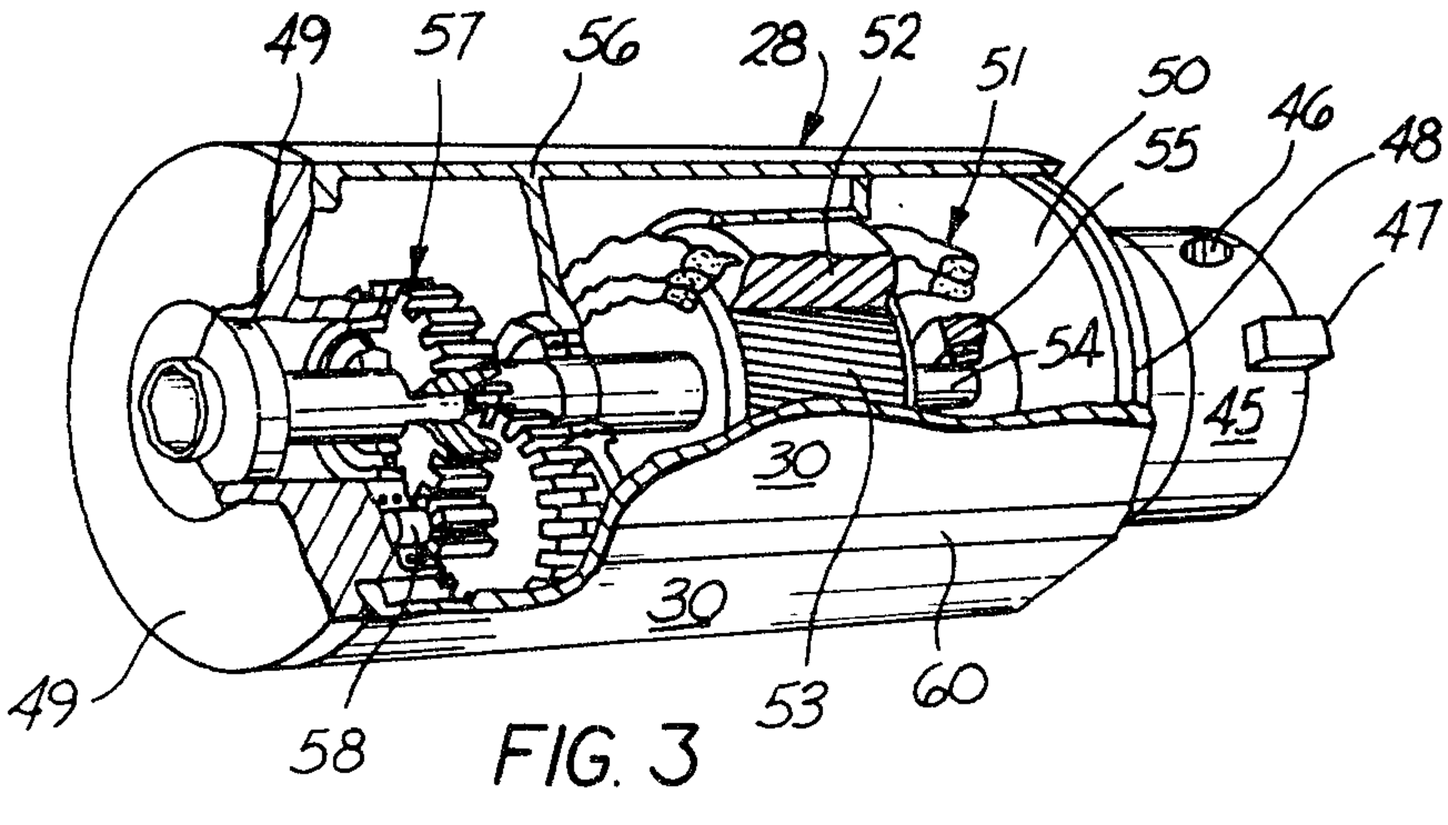

FIG. 3

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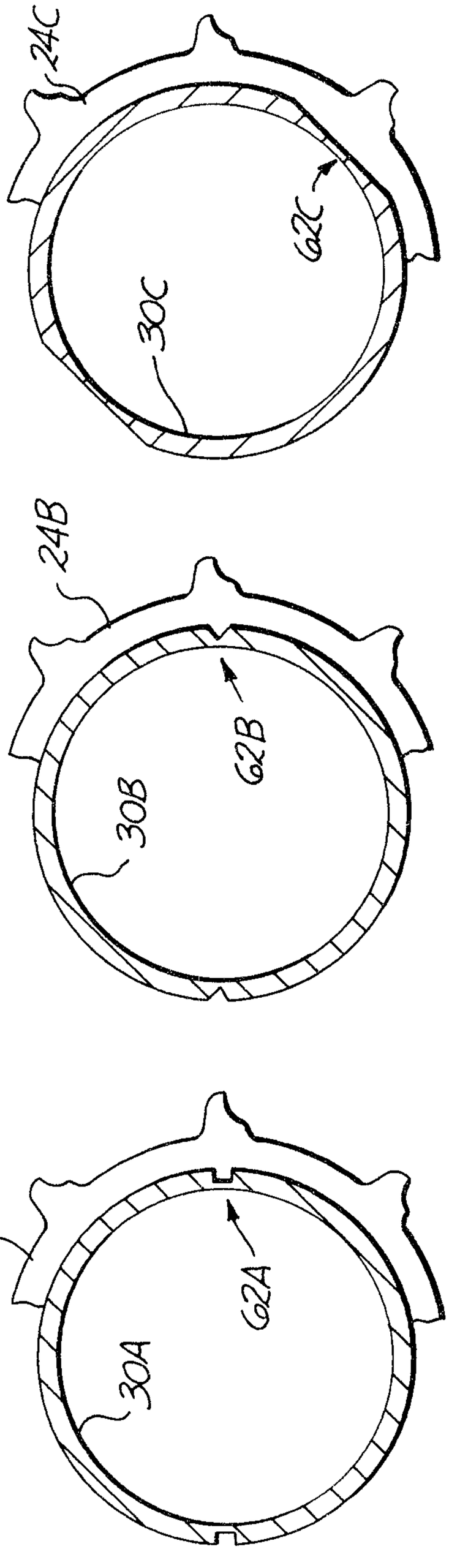

FIG. 6

FIG. 5

FIG. 4

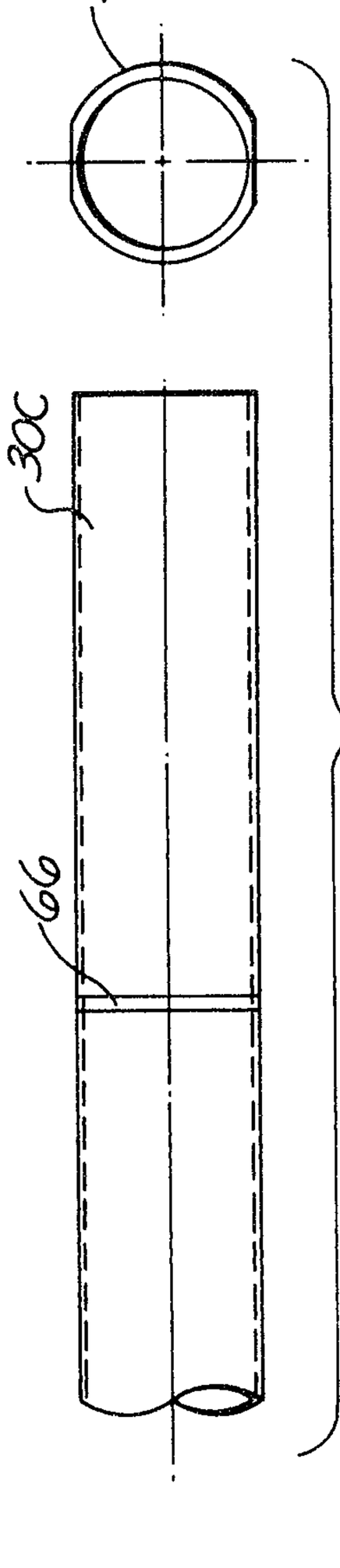

FIG. 7

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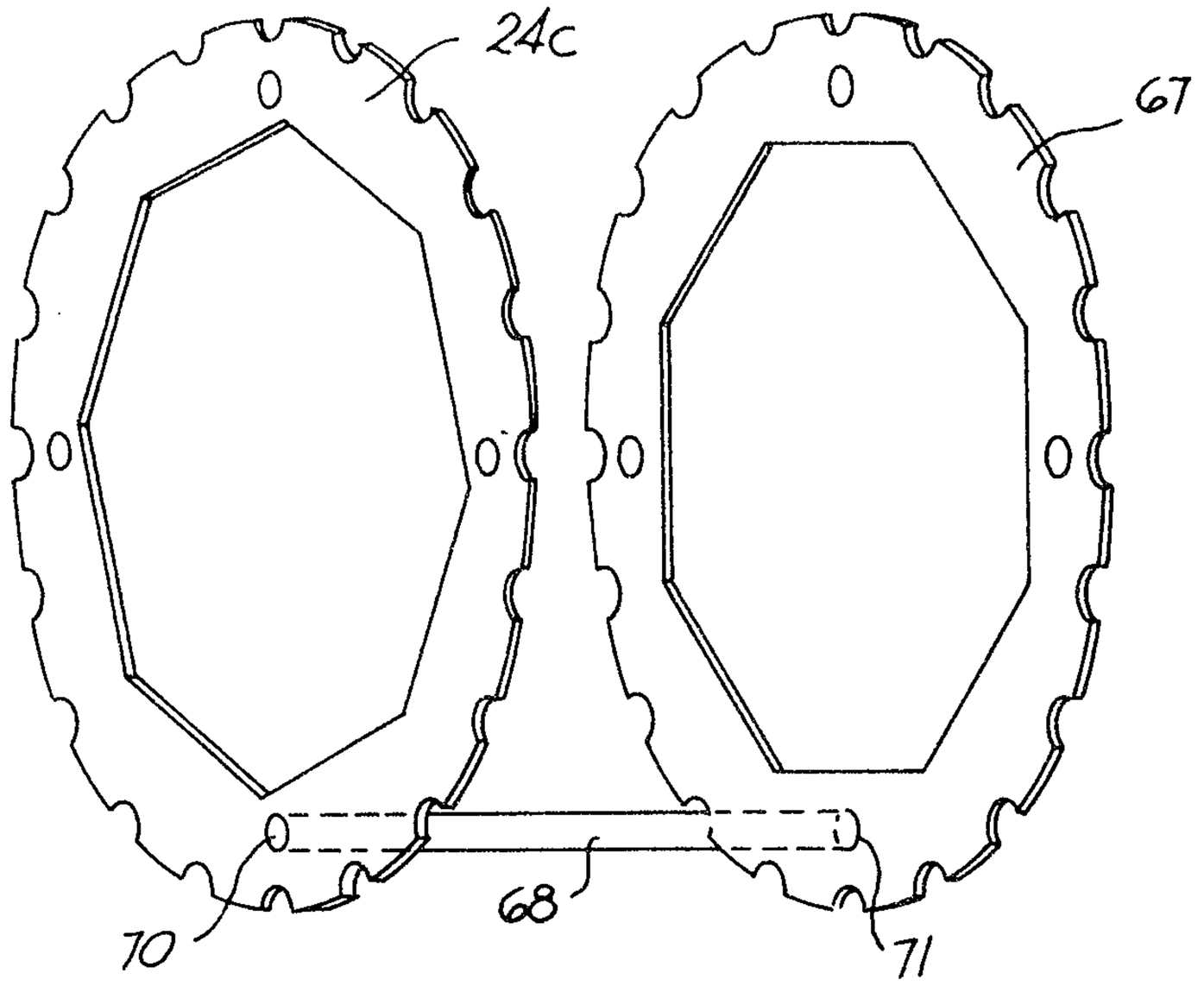

FIG. 8

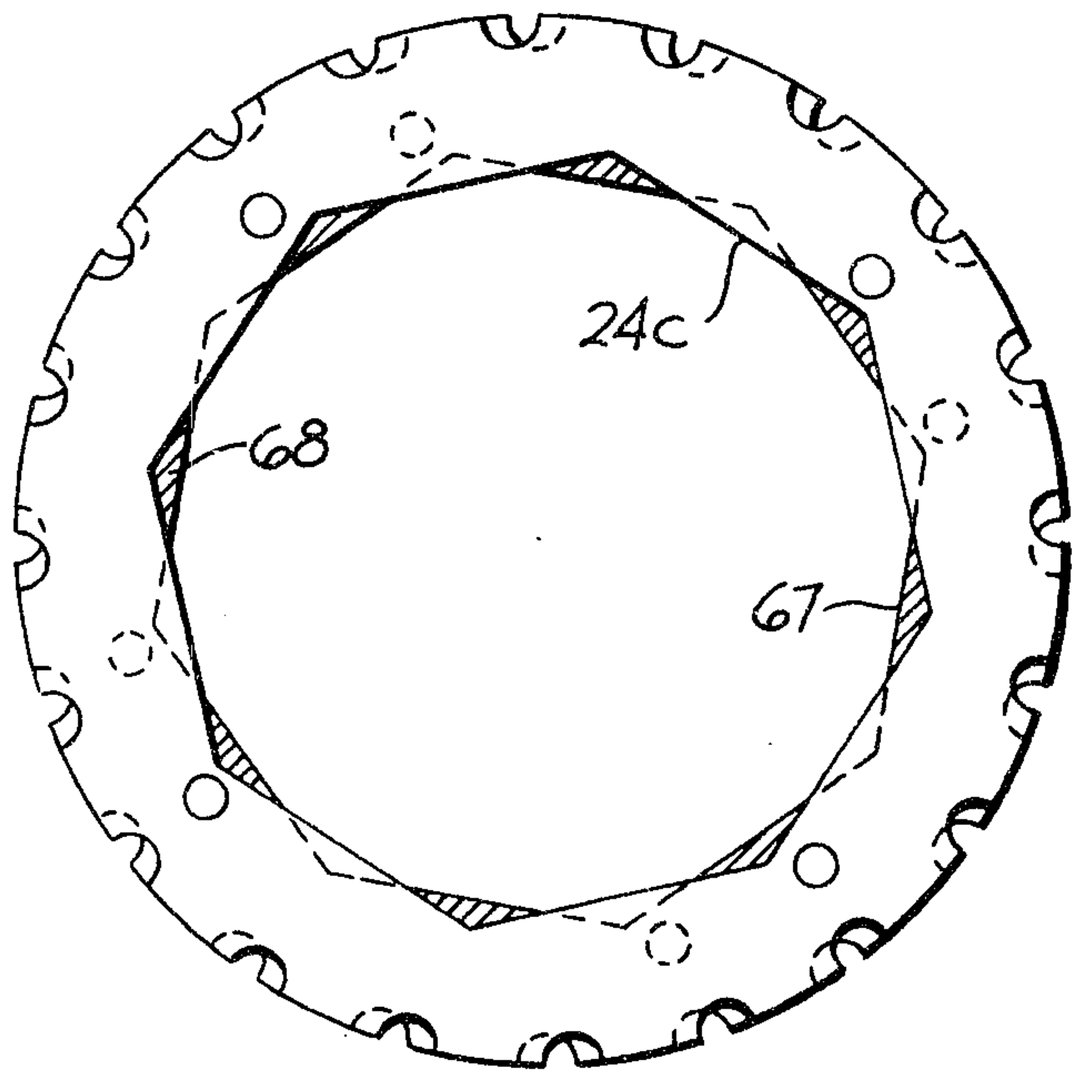

FIG. 9

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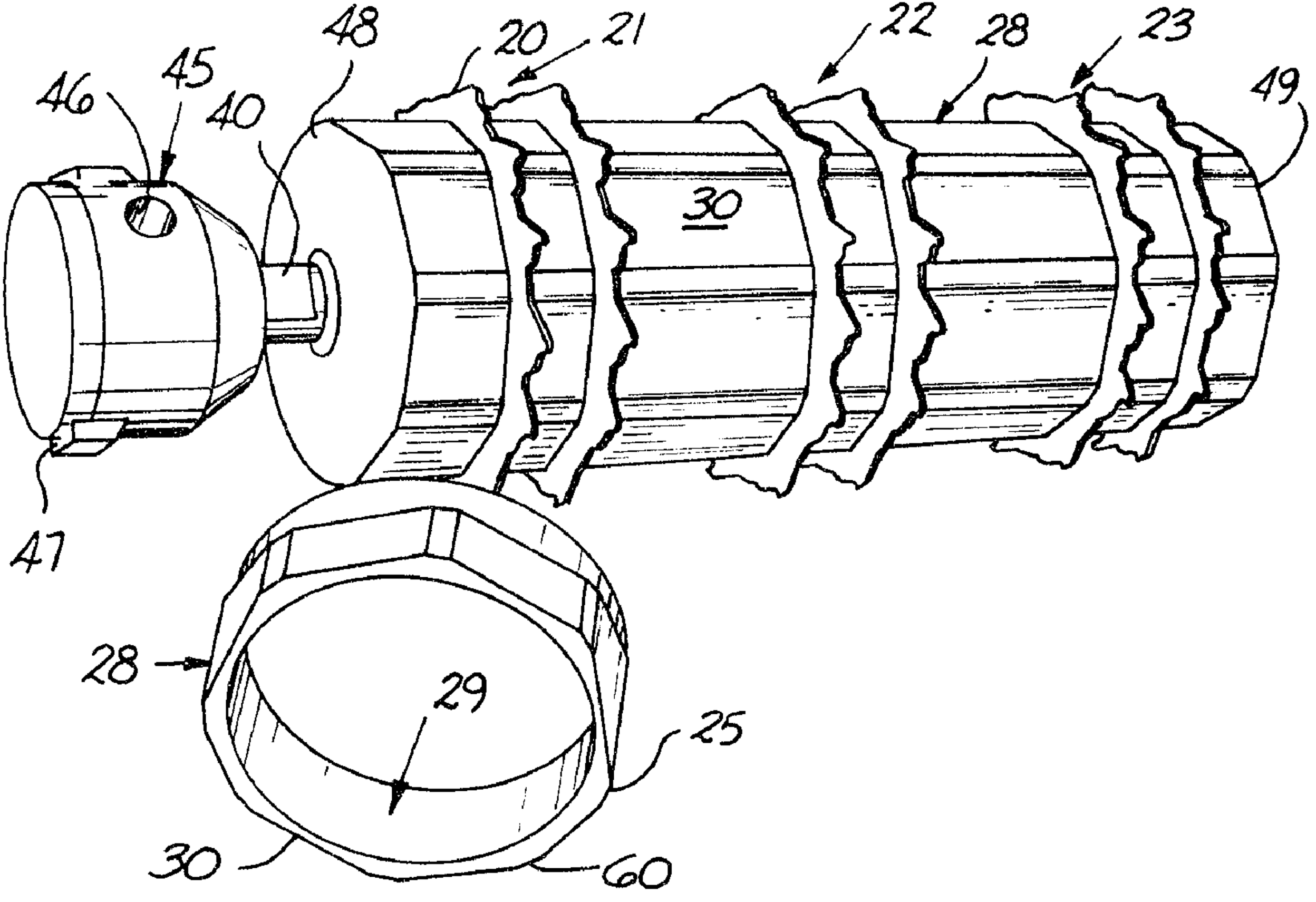
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