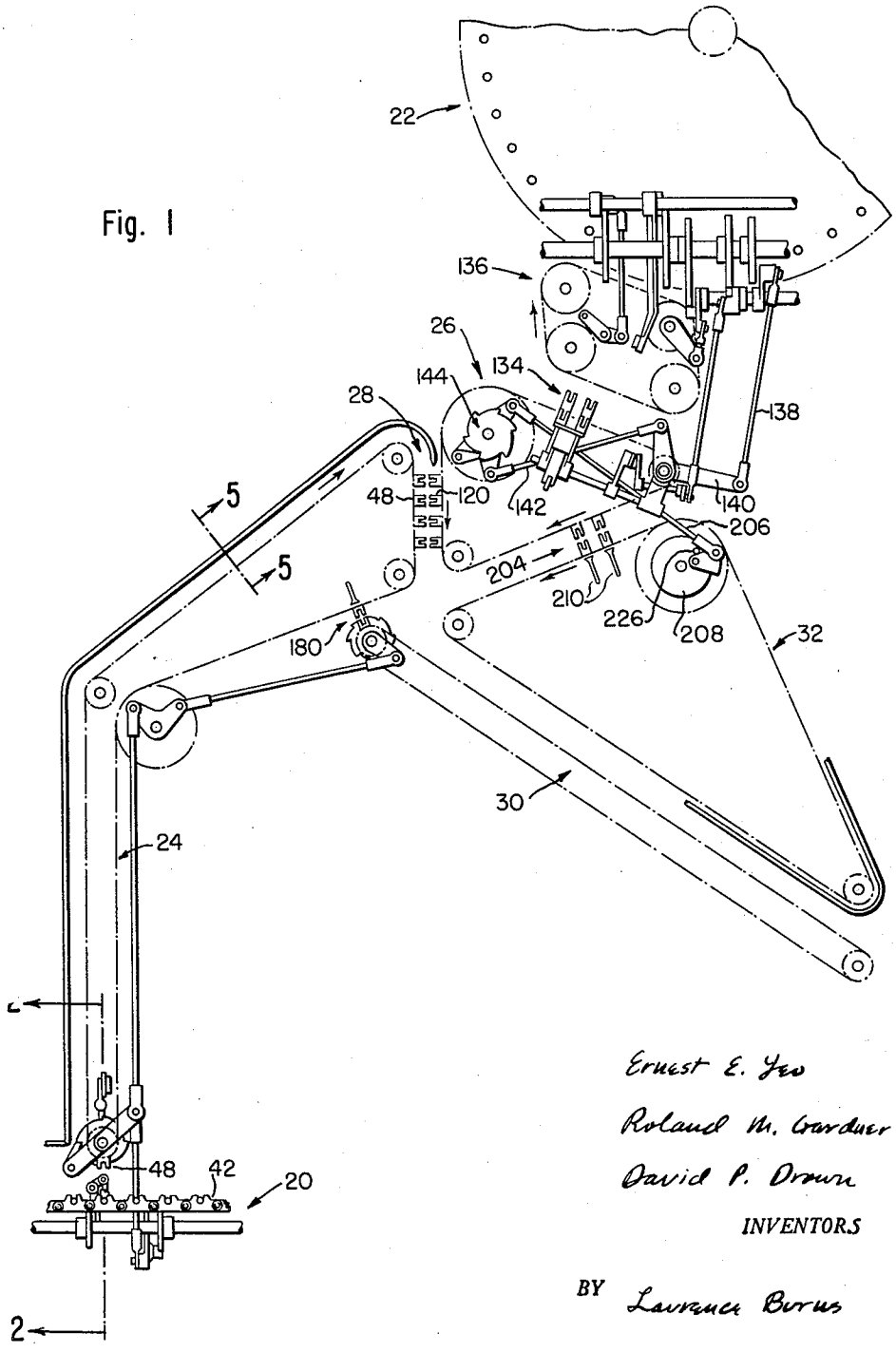
Nov. 15, 1960 R. M. GARDNER ET AL 2,960,205

LAMP MOUNT TRANSFER

Filed June 15, 1955 9 Sheets-Sheet 1

Fig. 1



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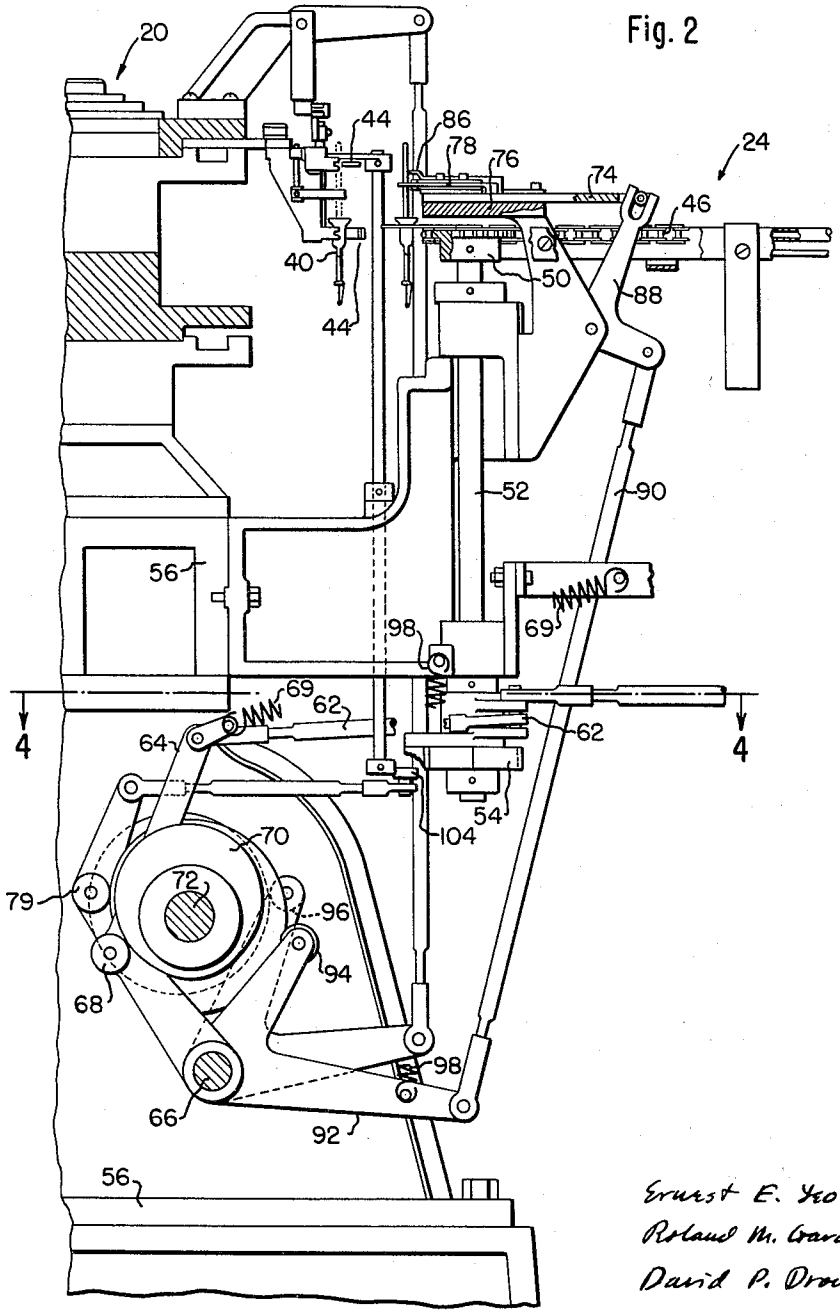
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LAMP MOUNT TRANSFER

Filed June 15, 1955 9 Sheets-Sheet 2

Fig. 2



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LAMP MOUNT TRANSFER

Filed June 15, 1955 9 Sheets-Sheet 3

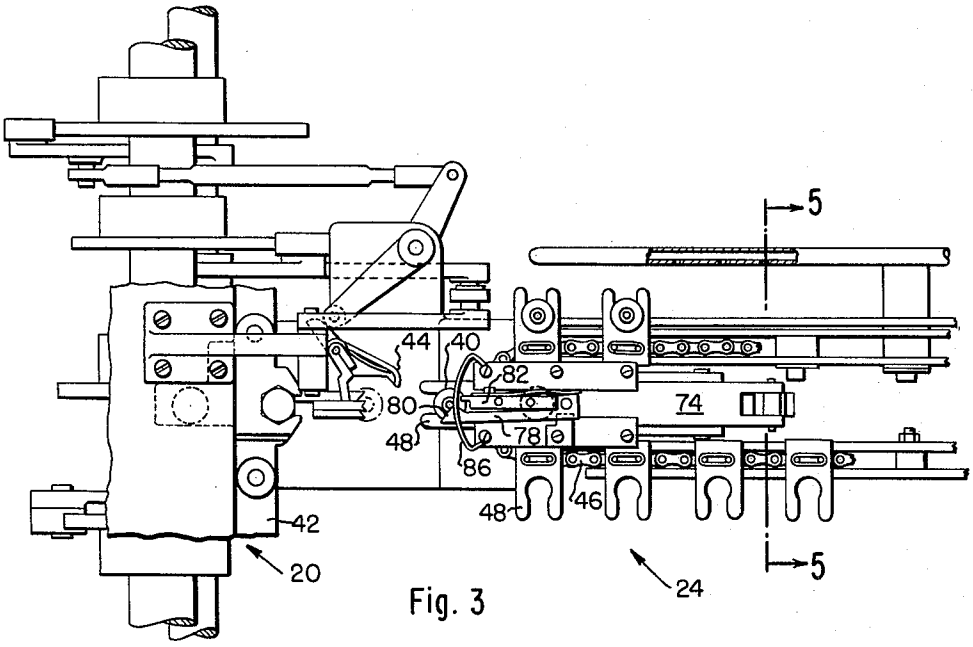
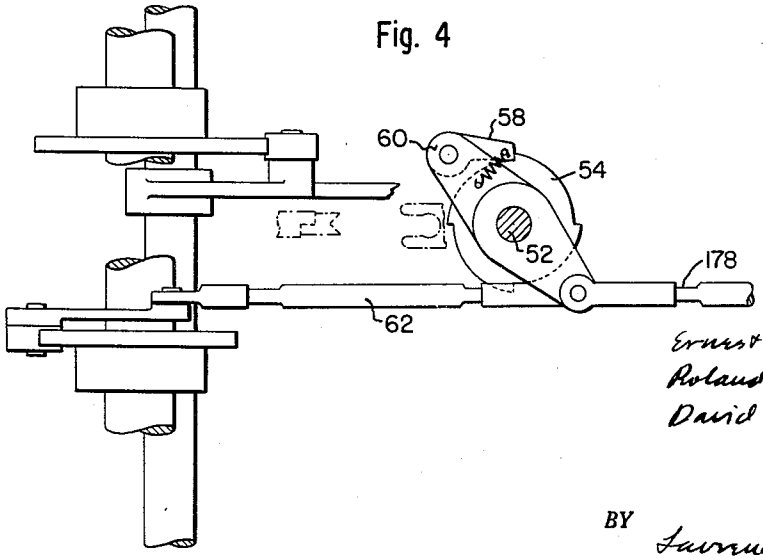


Fig. 3

Fig. 4



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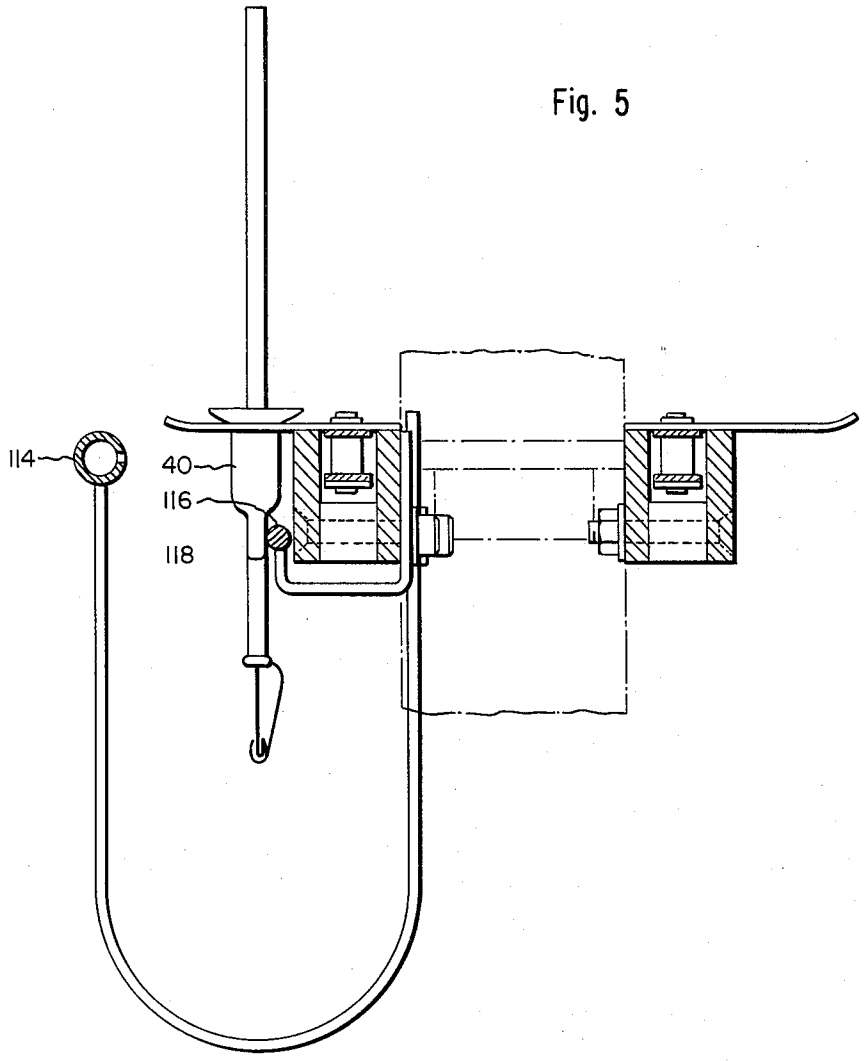
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LAMP MOUNT TRANSFER

Filed June 15, 1955 9 Sheets-Sheet 4

Fig. 5



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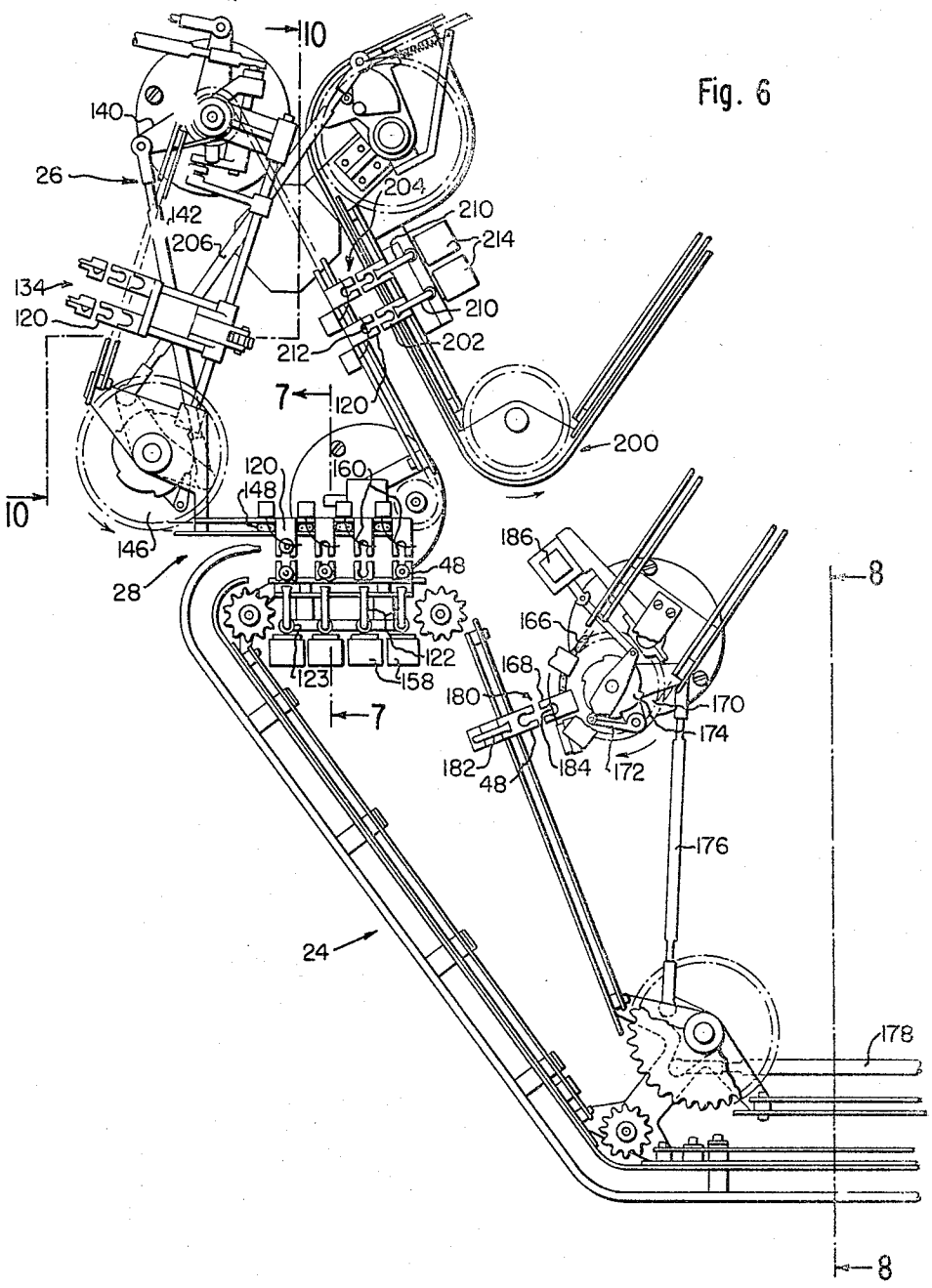
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LAMP MOUNT TRANSFER

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Fig. 6



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LAMP MOUNT TRANSFER

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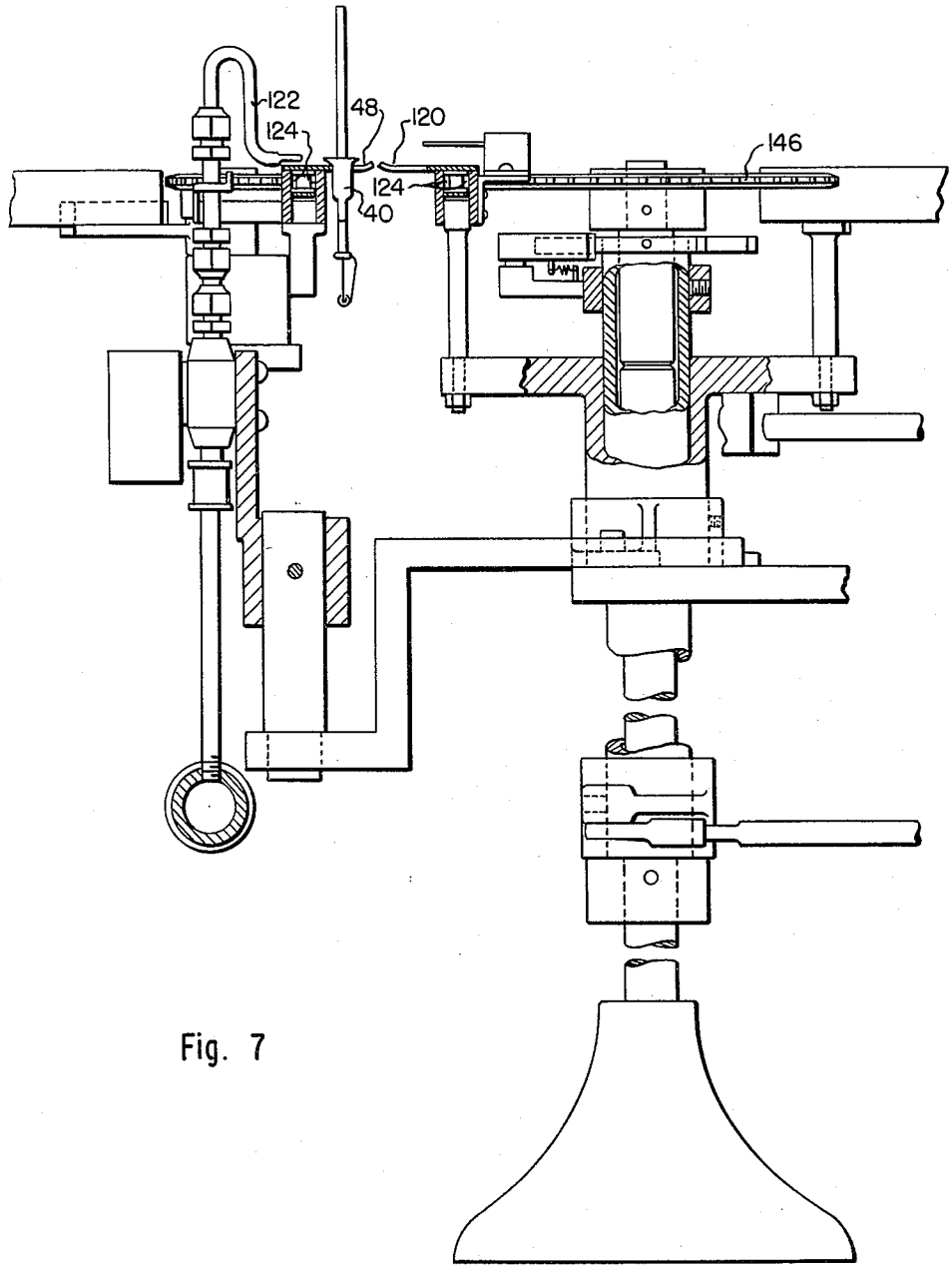


Fig. 7

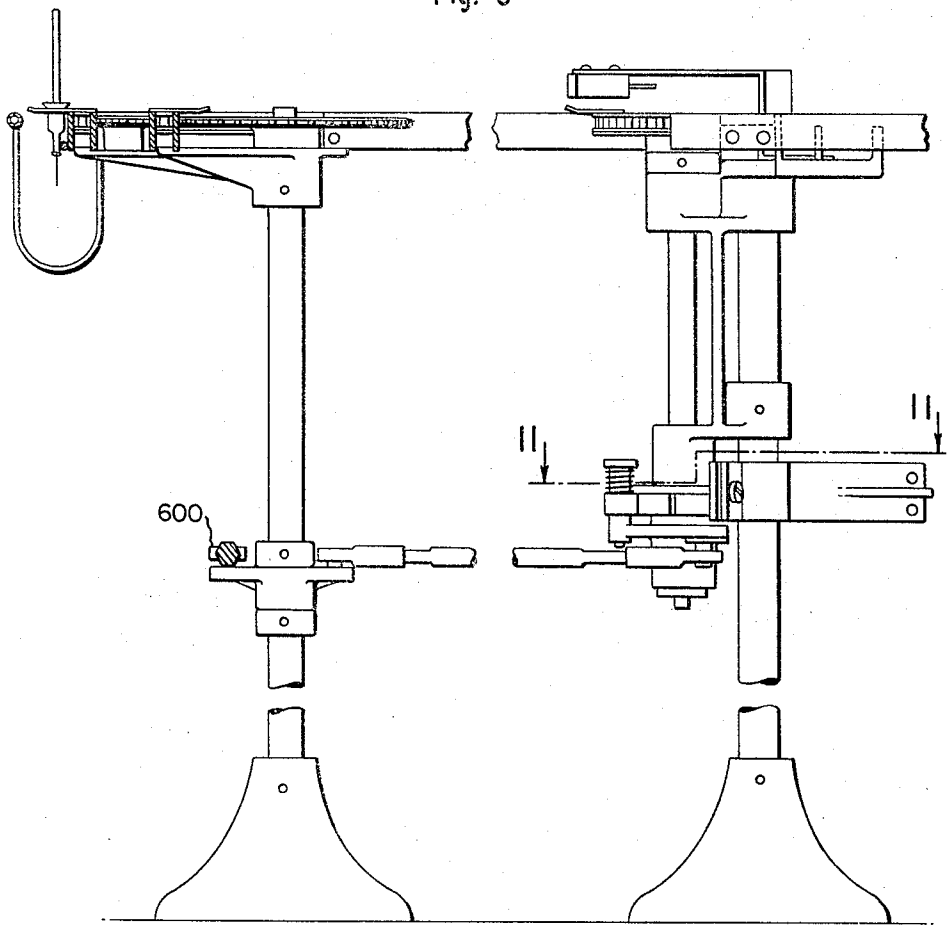
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Nov. 15, 1960 R. M. GARDNER ET AL 2,960,205

LAMP MOUNT TRANSFER

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Fig. 8



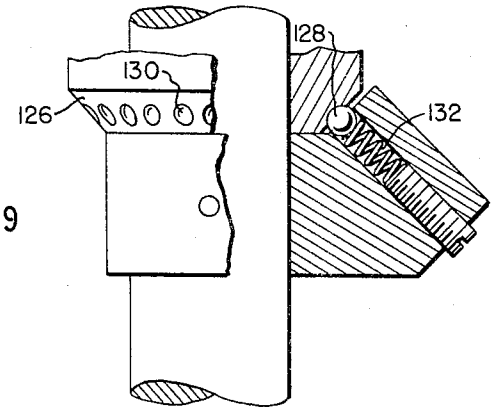


Fig. 9

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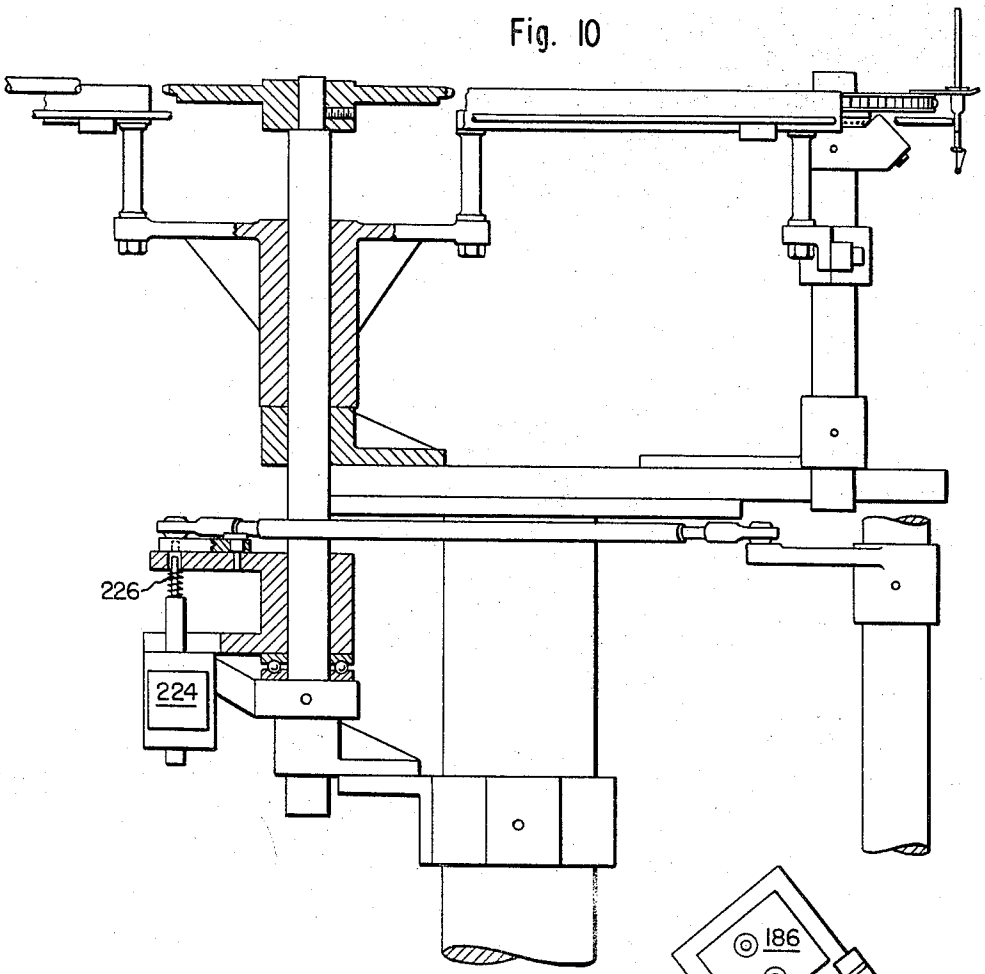
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Nov. 15, 1960 R. M. GARDNER ET AL 2,960,205

LAMP MOUNT TRANSFER

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Fig. 10



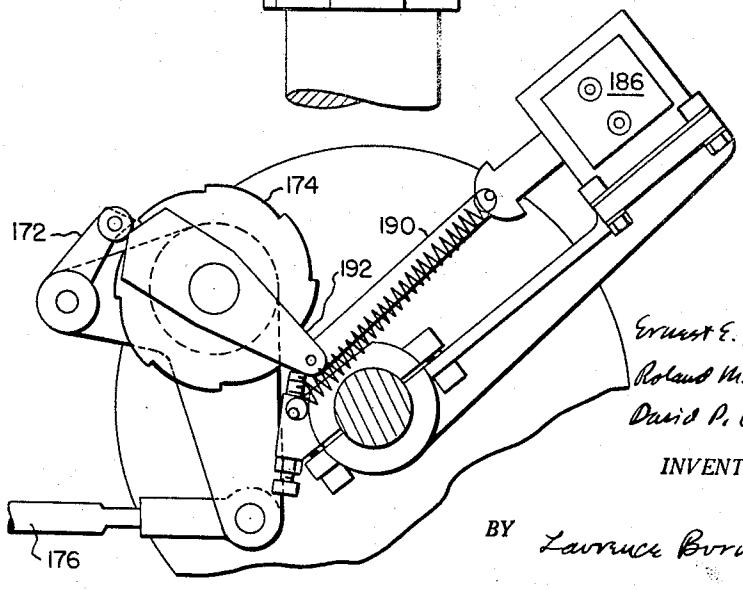


Fig. 11

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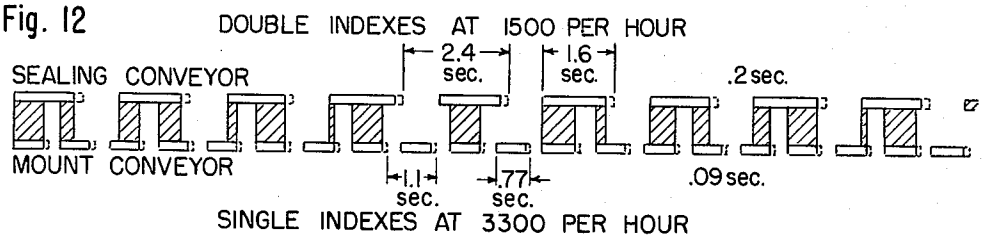
BY Lawrence Burns
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Nov. 15, 1960 R. M. GARDNER ET AL 2,960,205

LAMP MOUNT TRANSFER

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Fig. 12



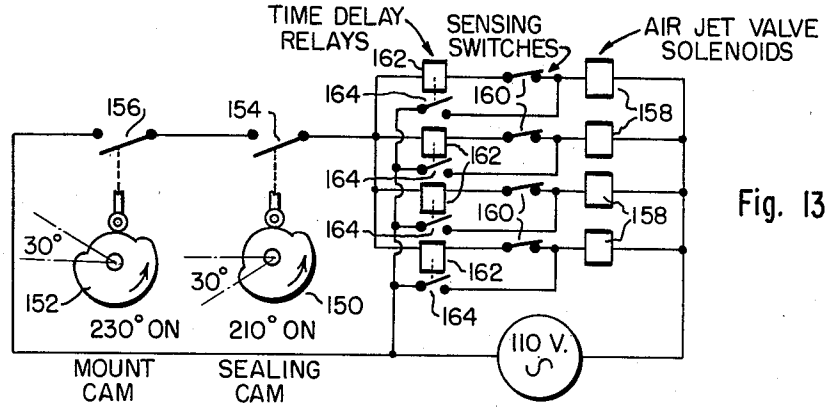
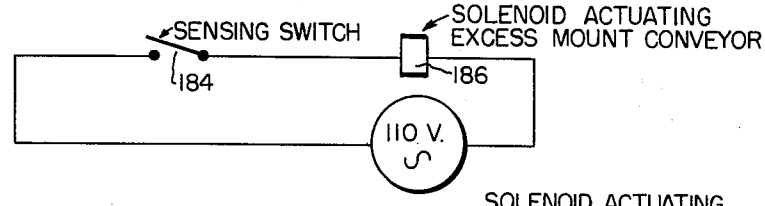


Fig. 13

Fig. 14



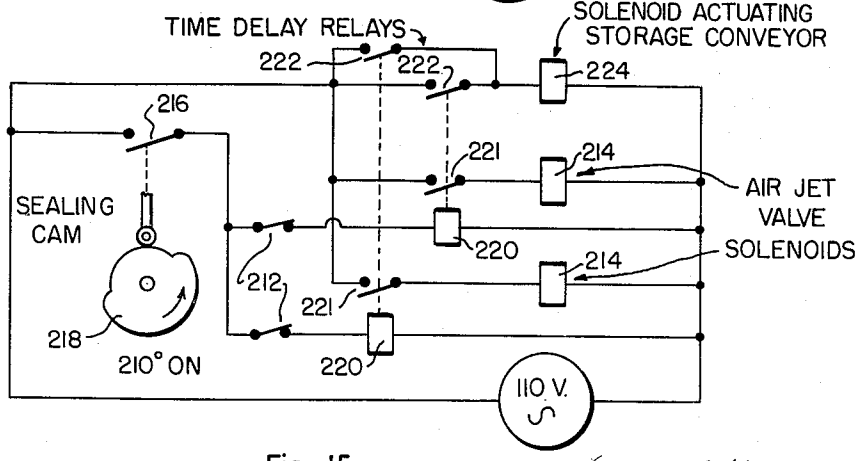


Fig. 15

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United States Patent Office 2,960,205 Patented Nov. 15, 1960

2,960,205

LAMP MOUNT TRANSFER

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Filed June 15, 1955, Ser. No. 515,724

11 Claims. (Cl. 198—21)

This invention relates to article transfer apparatus, and more particularly to apparatus for transferring articles from one machine to another in the lamp-making art. In one aspect it relates to apparatus particularly adapted to feed lamp mounts from a mount making machine to a sealing machine. It is further adapted for use between machines operating at different speeds, but need not be limited to such use.

Although the basic concept of our invention may be employed in a multiplicity of applications, it is specifically directed to solving the problems of integrating the various processes in the manufacture of electric lamps. In the production of incandescent lamps, for example, manufacturing operations are carried out successively on machines of four distinct types: lamp stem or mount making machines, sealing machines, exhaust machines, and basing machines. Since this invention is concerned with integration of operation between these machines, we will proceed first with a brief general description of them, placing particular emphasis on the aspects thereof that bear on the problem of integration. Such a general description will set forth the context of our invention and thereby make its objects and features more easily understood.

MOUNT MAKING MACHINE

The first step in fabricating lamps is usually that of assembling and forming a lamp stem or mount. This step is typically carried out automatically in a machine of the type disclosed in U.S. Patent No. 2,637,144 owned by the assignee of this application. The mount comprises all the parts of the lamp lying within the envelope and the base, and may be regarded as the major internal component of the whole assembly. In the mount making machine, parts are fed to each of a plurality of heads mounted on a conveyor. The heads are indexed in turn to a plurality of work stations, each equipped with one or more instrumentalities adapted to perform a series of intricate operations at high speed to complete a mount. Before reaching a discharge station each mount goes through an inspection station where defectives are removed from their respective heads. Although the machine itself is highly efficient, its production rate is not uniform, and at the discharge point, between 5% and 10% of the heads are apt to be vacant as the result of the rejection of defective mounts. At the delivery point, a completed mount, in filament-down position, comprises a stem tube having a flared upper end with an exhaust tube and lead-in wires passing down through its center and sealed to the stem tube at its lower end in an area where the glass of the stem tube is flattened against them. The filament and support wires extend through the glass below the lower end of the stem tube, and since they are relatively delicate, they must be handled carefully and separately in order to preserve them and keep the filaments from getting tangled.

SEALING MACHINE

Completed mounts coming from the mount machine are next introduced into an automatic sealing machine where they are placed, filament up, in a spindle of a sealing head mounted on a rotating turret in the sealing machine. Thereafter a glass envelope or bulb is deposited on a suitable support over the mount. In this position the neck portion of the bulb encompasses the periphery of the flared end of the stem tube. The mount and bulb are then indexed around the sealing machine to a number of stations where a series of burners are played upon the neck of the envelope to render it plastic and urge it into sealing relation with its mating mount surface. Additionally, before being unloaded from the sealing machine, the neck portion of the envelope is molded to accommodate a base which will be attached to it in a final stage of manufacture.

EXHAUST MACHINE

The completion of the sealing operation leaves the mount sealed into the bulb with the exhaust tube and lead-in wires protruding below. The lamp is then transferred to an exhaust machine. Upon entrance into the exhaust machine, the exhaust tube is inserted into a vacuum chuck mounted on a turret and thereafter it is indexed to a number of stations at which the lamp is evacuated, flushed, and filled with inert gas. At a final station, closure of the exhaust tube or tipping-off is effected by a tipping torch. It is general practice to provide at an earlier station a wire-wiping mechanism whose function is to displace the lead-in wires from their initial position adjacent the exhaust tube so that they will not be burned off by the tipping torch.

BASING MACHINE

The final step in the manufacture of the lamp, that of attaching the base, is performed on a basing machine. This machine consists of a carrier having an intermittent motion for moving a plurality of basing heads mounted at substantially equal intervals on the carrier successively to a plurality of stations. In loading the head, one of the lead-in wires is threaded through a central eyelet of the base while the other, usually referred to as the side, or fuse wire is wedged between the envelope and the encompassing base. At the various stations, the lead-in wires are cut to proper length; a series of burners are played upon the base to cure a quantity of cement contained therein thereby bonding the base to the envelope; and the lead-in wires are connected to their respective portions of the base by soldering or welding.

MANUAL LOADING

These machines have, in the past, been operated as individual units and feeding or loading of each machine has generally been accomplished manually. One exception to manual loading has been that wherever sealing and exhausting have been performed on the same or on adjacent turrets operated synchronously, simple transfer mechanisms have usually been provided to move lamps from sealing to exhaust positions. But because of many serious difficulties which first had to be overcome, sealing and basing machines have generally been loaded by hand. As a result, production rates have for many years been limited almost entirely by the speed with which an operator could load the machines. It has long been felt, however, that significant increases in production could be achieved from an array of these machines coordinated into a single productive unit by means of automatic transfer and loading mechanisms.

TRANSFER PROBLEMS: MOUNT MACHINE TO SEALING MACHINE

As applied to lamp making, our invention is specifically directed to the problems of transferring mounts

from a mount machine to a sealing machine in such a manner that coordination may be feasible. Some of the problems presented would have to be solved by any apparatus for mechanically loading mounts, while others are presented only in an integrated arrangement such as that contemplated.

(A) *Orientation of lead-in wires*

Among the problems presented is that of orienting the lead-in wires so that the proper wire may be threaded mechanically through the central eyelet of the base at the basing machine. It will be appreciated that both lead-in wires are not alike; one wire, which serves as a fuse, is relatively thin and of steel, whereas for the other a heavier copper wire is employed. Heretofore threading of the proper lead-in wire through the base eyelet has been accomplished manually by the operator who loads the machine. With manual threading, orientation of the lead-in wires is unimportant because the operator picks out the one which will be threaded through the eyelet. When this operation is to be mechanized, however, selection of the proper lead-in wire and its positioning are entirely dependent upon a definite orientation of the wire to be threaded, since a mechanism capable of finding the lead-in wires and distinguishing between the two would be unduly complex. While orientation of lead-in wires is readily maintainable in the machines, it is necessary that the mount be inserted into the sealing machine spindle with its lead-in wires correctly placed so that, at the basing machine, the proper wire will be located in position for threading. In other words, transfer from the mount making machine to the sealing machine must be done without disturbing the alignment of the mount and its lead-in wires.

(B) *Loading speed*

Another problem relates to loading speed. Until recently, sealing turrets have been operated at a relatively slow maximum speed of approximately 1500 single indexes per hour. Even then, experienced operators, paying no attention whatsoever to lead-in wire positioning, have been able to load only between 1400 and 1450 mounts per hour. But a sealing machine has now been developed which employs a double index and has a production potential of 3000 sealed lamps per hour. Obviously, in order to achieve this greater productivity, substantially faster loading mechanisms are necessary.

(C) *Individual handling*

The problems of loading mounts at high speed and of concurrently preserving the orientation of their lead-in wires is further complicated by the delicacy and fragility of the mounts themselves and the tendency of the filaments to snag and tangle. For this reason, each mount must be handled separately and without opportunity to contact adjacent mounts.

(D) *Coordination between mount machine and sealing machine*

A particularly vexing problem relates to coordinating the output of the mount machine with the input requirements of the sealing machine. In order to operate the sealing and subsequent machines efficiently, a mount must be furnished to each sealing head as it comes to a loading position on the sealing turret. But it will be remembered that a certain percentage of the heads on the mount making machine are vacant upon arrival at the discharge station, their mounts having been removed as defective at a prior station. If the mount making and sealing machines were operated in synchronism and the output of the first machine simply fed to the second, vacancies would occur on the sealing turret corresponding to the rejected defective mounts. To make up for these vacancies it is necessary that the mount making machine be operated at a greater speed than the sealing machine. It has been found from experience that a difference of about 9% in the speeds of the two machines is desirable to produce a slight excess of mounts during what may be termed periods of normal operation.

Still another problem involved in transferring mounts from a mount making machine to a sealing machine comes from the fluctuating performance of the mount making machine over successive short intervals of time. Assuming for purposes of illustration that the sealing and mount making machines are being operated at respective rates of 3000 and 3300 per hour, the sealing machine will require 25 pairs of mounts every minute to produce at capacity. But although over a period of a day the average net production of the mount machine is somewhat in excess of 50 mounts per minute, yet the number of units produced in successive one-minute intervals might vary from a maximum of 55 to a minimum of 45 or even less. It is therefore necessary to make provisions to accumulate excess mounts during periods of better than average efficiency and to supply missing mounts when efficiency is below average.

OBJECTS

A general object of our invention is mechanization of material handling.

A second general object of our invention is improvement of production efficiency through coordination of machines which have heretofore been operated as independent units.

Still another general object of our invention is to accomplish the feeding of machines operating at rates at which manual loading is impractically slow.

An additional object of our invention is to achieve a transfer of articles between machines operating at different rates.

A more specific object of our invention is the provision of apparatus which will at one and the same time transfer mounts from a mount making machine to a sealing machine at rates substantially in excess of manual loading rates, and maintain a substantially fixed orientation of the lead-in wires of the mount. Still another specific object is the provision of such an apparatus which will also compensate for the varying production rates of the mount making machine in transferring mounts to the sealing machine while at the same time filling the entire input requirements of the sealing machine.

FEATURES

In the accomplishment of these and other objects of our invention in a preferred embodiment thereof, we transfer mounts from a mount machine to a sealing machine by a pair of conveyors, each of which carries a multiplicity of mount holders or cradles. One of the conveyors picks up the mounts from the mount machine and the other conveyor delivers the mounts to the sealing machine. For convenience of terminology, we will refer to the conveyor that takes the mounts from the mount machine as a "mount conveyor," and the conveyor that delivers the mounts into the sealing machine as a "sealing conveyor." At an intermediate point, these two conveyors are disposed side by side in parallel relation and in this area of juxtaposition or "transfer area," a major portion of the mounts are transferred from the mount conveyor to the sealing conveyor. However, since the mount conveyor operates in unison with the mount machine on the basis of single indexing and the sealing conveyor operates in unison with the sealing machine on the basis of double indexing, and since the mount machine operates at a faster rate than the sealing machine, there are times when the mount holders in the transfer area may not be in juxtaposition long enough to effect a safe transfer of a mount from one carrier to the other. In our invention we overcome this problem by mechanism which prevents the transfer of a mount from the mount conveyor to the sealing conveyor whenever the period of juxtaposition will be so short that a safe transfer cannot be completed. In order to minimize the time delay

necessary for safe transfer, it is highly desirable to transfer mounts from the mount conveyor to the sealing conveyor extremely rapidly, and in our invention we accomplish this by means of an air jet directed at the mounts on the side of the mount conveyor and adapted to propel the mount across to the sealing conveyor by a short blast of air. In this way no mechanical arms or other parts remain in the path of either conveyor so that immediately after the transfer has been completed either conveyor may advance. It is a further feature of our invention that the air blast transfer has the effect of lifting the mounts free and clear of the mount holders on the conveyor so that during the transfer from one conveyor to the other, there is little or no tendency for the mounts to rub against the side walls of the mount holders and thereby twist or otherwise disturb the orientation of the mounts or their lead-in wires.

Due to the somewhat sporadic output rate of the mount machine and also due to the fact that the mount machine operates at a faster rate than the sealing machine to compensate for rejection of mounts, there will be times when the period in which a safe transfer may be made will be too short. At such times the sealing conveyor may advance beyond the transfer area without mounts in every mount holder. In addition, during periods of full production by the mount machine, the mount conveyor will carry excess mounts beyond the transfer area between the mount conveyor and the sealing conveyor. In order to compensate for these conditions, we provide a second pair of conveyors which may be labeled, for convenience, a storage conveyor and an excess mount conveyor. The storage conveyor is aligned in juxtaposition with the sealing conveyor in position to transfer mounts to any holder on the sealing conveyor that may remain vacant after it has passed the transfer area between the mount conveyor and the sealing conveyor. The excess mount conveyor is located adjacent to the mount conveyor in position to pick up any mounts on the mount conveyor that may be carried over beyond the transfer area. In addition, the excess mount conveyor and the storage conveyor pass adjacent to each other in position for convenient transfer of mounts from the excess mount conveyor to the storage conveyor. Since the storage conveyor is independent of the operation of the mount machine, it may be driven simultaneously with the sealing conveyor, and mount holders between the storage conveyor and the sealing conveyor may be placed in alignment for a sufficiently long time to be certain that a mount transfer can take place. Thus, it is a primary feature of our invention that the mount holders on the sealing conveyor are always fully loaded and the full input requirements of the sealing machine are met despite the fact that the output rate of mounts from the mount machine fluctuates.

Further objects and features of our invention will be best understood and appreciated from a detailed description of a preferred embodiment thereof, selected for purposes of illustration and shown in the accompanying drawings, in which:

Fig. 1 is a partly diagrammatic plan view of the general components of the transfer mechanism of our invention;

Fig. 2 is a view in side elevation of the mechanism for transferring mounts from the mount machine to the mount conveyor taken along the lines 2—2 of Fig. 1;

Fig. 3 is an enlarged plan view of the mechanism for transferring mounts from the mount machine to the mount conveyor;

Fig. 4 is a plan view of the drive mechanism for the mount conveyor taken along the lines 4—4 of Fig. 2;

Fig. 5 is a sectional view in end elevation taken along the lines 4—4 of Fig. 1;

Fig. 6 is an enlarged plan view of the transfer areas between the mount, sealing, storage and excess mount conveyors;

Fig. 7 is a view in side elevation of the transfer area between the mount conveyor and the sealing conveyor taken along the lines 7—7 of Fig. 6;

Fig. 8 is a view in side elevation of the mount conveyor taken along the lines 8—8 of Fig. 6;

Fig. 9 is a cross sectional view in side elevation of the positioning mechanism used in each of the various conveyors;

Fig. 10 is a cross sectional view in side elevation of the sealing conveyor and its drive linkage connection to the drive of the storage conveyor taken along the lines 10—10 of Fig. 6;

Fig. 11 is a plan view of the drive arrangement for the excess mount conveyor as may be seen along lines 11—11 of Fig. 8;

Fig. 12 is a diagrammatic illustration of the time sequence of operations of the mount and sealing conveyors;

Fig. 13 is a wiring diagram of the circuitry involved in actuating the air jet valves for transfer of mounts between the mount conveyor and the sealing conveyor;

Fig. 14 is a wiring diagram of the actuating mechanism for indexing the excess mount conveyor; and

Fig. 15 is a wiring diagram of the circuitry involved in actuating the air jets and the indexing mechanism of the storage conveyor.

GENERAL ORGANIZATION

The general organization of the preferred embodiment of our invention herein shown may be seen diagrammatically in Fig. 1, and includes a mount making machine indicated at 20 and a sealing machine indicated at 22. Adjacent to the mount making machine 20, we locate a mount conveyor indicated at 24, and adjacent to the sealing machine 22, we locate a sealing conveyor 26. The conveyors 24 and 26 are disposed adjacent and parallel to each other at a transfer area indicated at 28. An excess mount conveyor indicated at 30 is located adjacent to the mount conveyor 24 in position to pick up mounts on the mount conveyor which may have passed the transfer area 28 without being transferred to the sealing conveyor 26. Furthermore a storage conveyor indicated at 32 is located adjacent to the sealing conveyor 26 in position to transfer mounts to the sealing conveyor whenever the sealing conveyor has not been fully loaded at the transfer area 28. Finally, the excess mount conveyor 30 is positioned adjacent to the storage conveyor to facilitate convenient transfer of mounts.

Other mechanisms included in the general organization of our invention comprise the actuating and driving arrangements for the various conveyors, the mount holders and guide rods for conveying the mounts, the transfer apparatus employed in propelling mounts by air jet from conveyor to conveyor with a minimum disturbance of their orientation, and the control mechanisms for actuating transfer of mounts from conveyor to conveyor at the proper time and in the proper sequence. These general elements of our invention cooperate in achieving the objects stated above, and for purposes of organization and clarity this description will proceed from element to element through the apparatus in the same general path as may be followed by a mount as it is transferred from the mount making machine 20 to the sealing machine 22.

TRANSFER FROM MOUNT MAKING MACHINE TO MOUNT CONVEYOR

The apparatus for transferring mounts from the mount making machine 20 to the mount conveyor 24 may be seen in Figs. 1–5. Mounts 40 are carried in the mount making machine 20 on an endless chain link conveyor 42 which is advanced from station to station by indexing mechanism, not shown. The mounts 40 are held in open jaws 44 (see Fig. 3) on the conveyor 42. The mount conveyor 24 likewise includes an endless chain conveyor 46 which carries mount holders or cradles 48 in spaced

relationship along its length. The holders 48 are simple flat U-shaped members adapted to cradle a mount with the flared portion of the mount stem resting in slightly widened areas at the base of the arms of the U. At the pick-up point between the mount machine 20 and the mount conveyor 24, the mount holders 48 come into alignment with the jaws 44 of the conveyor 42 of the mount making machine 20, and when these two elements are in alignment, mounts 40 are transferred from the mount making machine 20 to the mount conveyor 24.

In order to provide an exact registration between the mount holders 48 of the mount conveyor 24 and the jaws 44 of the mount machine 20, mechanism is provided for indexing the mount conveyor 24 ahead from station to station in unison with the chain link conveyor 42 of the mount making machine 20. This mechanism is shown in Figs. 2 and 4 and consists generally in a sprocket 50 adapted to drive the link chain 46. The sprocket 50 is mounted on a vertical shaft 52 extending downwardly through the apparatus to a ratchet wheel 54. Sprocket 50, shaft 52 and ratchet wheel 54 are supported in suitable bearings connected to the base 56 of the mount making machine 20 and will not be described in further detail. The ratchet wheel 54 is driven by a spring loaded pawl 58 pivotally mounted on a pawl arm 60, likewise pivotally mounted on the shaft 52. The pawl arm 60 is operated by a tie rod 62 which is in turn driven by a rocker arm 64 pivoted at 66 to the base 56 of the mount making machine 20. The rocker arm 64 carries a roller 68 in position to engage a cam 70 mounted on cam shaft 72 which is driven in geared relation to the driving mechanism for the chain link conveyor 42 of the mount making machine 20. A spring 69 serves to return the rocker 64 to its starting position after the cam 70 has moved it to the limit of its stroke. These elements are preferably arranged in such a way that the mount holders 48 of the mount conveyor 24 move in unison with the jaws 44 of the chain link conveyor 42 of the mount making machine 20, coming to rest together and indexing forward together and simultaneously. Thus the mounts are in position for transfer during the entire period of rest of the indexing motion of the chain link conveyor 42 of the mount making machine 20.

During the said periods of rest, a mount transfer arm 74 positioned above the link chain 46 of the mount conveyor 24 is pushed forward from a position directly opposite the jaws 44 of the chain link conveyor 42 to engage a mount 40 thereon and transfer the same back to a mount holder 48 on the mount conveyor 24. The mount transfer arm 74 is supported and guided in a slide 76 connected through the support elements of the apparatus to the base 56 of the mount making machine 20. Mounts 40 are engaged and held by the transfer arm 74 by means of a spring loaded gripping arm 78 pivotally connected to the transfer arm 74 and being provided with a slanting wedge jaw 80 disposed adjacent to a fixed jaw element 82 mounted in opposed relation to the arm 78 and the transfer arm 74. The transfer arm 74 and its gripping elements engage the exhaust tube of the mounts 40 and after a pause, the transfer arm 74 is withdrawn and carries the mount along with it back into position in the mount holder 48. At this point the transfer arm 74 continues to withdraw and as the exhaust tube of the mount 40 comes up against a spring 86 mounted on the fixed support 76 of the transfer arm 74, gripping elements 78 and 82 are caused to release the mount by a cam located in slide 76, but not shown specifically herein. At this point the mount remains in the holder 48, and the link chain 46 is again ready to register forward to the next index station.

The mount transfer arm 74 is operated in proper sequence from the same cam shaft 72 which operates the indexing mechanism for the link chain 46. Thus with reference to Fig. 2, it will be seen that a rocker arm 88 mounted on the support elements of the apparatus drives the transfer arm 74 from the rear and is in turn actuated by a rod 90 communicating with a rocker arm 92 pivoted at 66 and being provided with a roller 94 which engages a cam 96 mounted on the cam shaft 72. The rocker arm 92, and hence the rod 90 and associated elements, are urged forward by the tension of a spring 98 and are returned to position by cam 96.

The jaws 44 carried by the conveyor 42 of the mount making machine 20 are opened to release the mounts 40 by appropriate cam action illustrated in Fig. 2, but not described in detail herein because it forms no part of this invention.

ORIENTATION OF MOUNTS ON MOUNT CONVEYOR

Once the mounts have been transferred to the holders 48 of the mount conveyor 24, they are carried forward with each index of the mount conveyor 24 along its path, and they are held in propor position of orientation on the mount conveyor 24 by means of air jets (see Fig. 5) which bear upon the mounts 40 from a perforated air tube 114 positioned adjacent to the mounts 40 as they pass along the periphery of the mount conveyor 24. The air jets push the mounts back against a rail 116 which bears against a flat portion 118 on the mounts and thereby serves to hold the mounts in proper orientation.

TRANSFER OF MOUNTS TO SEALING CONVEYOR

As the mounts come into the transfer area 28 on the mount conveyor 24, the mount holders 48 on the mount conveyor 24 come into registration with mount holders 120 on the sealing conveyor 26 and during periods of registration, mounts are blown across from one conveyor to the other by means of air jets 122 (see Fig. 6) located in position adjacent to the mount holders 48 when they index into the transfer area 28. The air jets 122 are controlled by solenoids 158 acting through valves 123. They direct air against the mount in the area of the lateral flare of the stem tube and have the effect of lifting the mounts 40 slightly and separating the same from the holding elements of the holders 48 so that the mounts travel across the holders 120 substantially free of the side walls of either the mount holders 48 or the mount holders 120. However, to further insure accuracy of alignment between the mount holders 48 and mount holders 120, we provide a pair of guide bars 124 (see Fig. 7) associated with the holders on each chain conveyor in the transfer area 28. Guide bars 124 straighten out the respective conveyors and prevent any slight misalignment in link elements that might otherwise be present.

CONVEYOR POSITIONING MECHANISM

As an additional measure for insuring accuracy of alignment between mount holders 48 and mount holders 120, we provide a ball and socket registering arrangement for the idler wheels of the various chain conveyors. This arrangement may be seen in Fig. 9 and consists in a sprocket-like rotating element 126 and a ball 128 fitting into shallow rounded depressions 130 in the rotating element 126. The ball 128 is urged into the depressions 130 by a compression spring 132. This arrangement serves to take up any random slack in the chain conveyors and positions the mount holders accurately after each index.

INDEXING OF SEALING CONVEYOR

In order to understand the sequence of transferring mounts in the transfer area 28, it is first necessary to understand the indexing operation of the sealing conveyor 26. As was previously stated, the sealing machine 22 operates by a method of double indexing and for this reason the sealing conveyor 26 must index ahead two stations at a time in order to provide the sealing machine with a pair of mounts 40 for each index of the sealing machine. In the preferred embodiment herein shown with reference to Fig. 1, it will be seen that mounts 40

leave the sealing conveyor at 134 and that an additional conveyor indicated at 136 actually serves to carry the mount around to the sealing machine 22. The conveyor 136 is provided with mechanism for turning the mounts over and for depositing them, exhaust tube down, in mount spindles of the sealing machine. However, since the conveyor 136 operates in precise synchronism with the sealing machine 22, one may regard the sealing conveyor 26 as giving up its mounts to the sealing machine in the area 134. Again referring to Fig. 1, it will be seen that the sealing conveyor 26 is driven in its double indexing motion by a tie rod 138 actuated by the drive mechanism of the sealing machine and operating through a rocker arm 140, a second tie rod 142, and pawl and ratchet mechanism indicated at 144 to turn a sprocket 146 which serves to drive a chain conveyor 148 (see Fig. 6), which in turn supports mount holders 120 previously described briefly. Guide bars 124 bear against the conveyor 148 in the portion thereof which lies adjacent the transfer area 28 to insure proper alignment of the holders 120. Also a ball and socket arrangement similar to that shown in Fig. 9 is employed in the support mechanism for the chain conveyor 148 so that accurate longitudinal registration of the holders 120 may be achieved.

TRANSFER OF MOUNTS FROM MOUNT CONVEYOR TO SEALING CONVEYOR

In the embodiment of our invention herein shown, the mount machine may operate at a rate of about 3300 single indexes per hour and the sealing machine may operate at an input rate of about 3000 mounts per hour, or in other words 1500 double indexes per hour. Thus the mount holders 48 will be advancing through the transfer area 28 at the rate of one station for approximately each 1.1 second, while the mount holders 120 of the sealing conveyor 26 will be advancing through the transfer area 28 at the rate of one double index for every 2.4 seconds.

In Fig. 12 we have shown graphically the time sequence of the indexing motions of the mount conveyor 24 and the sealing conveyor 26. Thus on the upper line where the time sequence of the sealing conveyor 26 is shown, a lapsed time of 2.4 seconds appears between the start of each indexing cycle, and the sealing conveyor 26 is at rest 1.6 seconds. On the other hand, the mount conveyor 24, whose time sequence is shown on the lower line, has a period of approximately 1.1 seconds between the start of each index and a period of rest of approximately .77 second.

In order to prevent the air jets 122 from starting to transfer a mount from the mount conveyor 24 to the sealing conveyor 26 while the conveyors are in motion, we provide a control mechanism for the operation of the air jets 122 shown diagrammatically in Fig. 13. The air jets 122 are supplied with compressed air through valves 123 which are opened and closed by spring-loaded solenoids 158. The air jet actuating mechanism is controlled basically by a cam 150 associated with the operation of the sealing conveyor 26 (labeled "sealing cam" herein for convenience) and a cam 152 associated with the operation of the mount conveyor 24 (labeled "mount cam" herein for convenience). The sealing cam 150 makes one complete rotation for each double index of the sealing conveyor 26 and the mount cam 152 makes one complete rotation for each single index of the mount conveyor 24. When the sealing conveyor 26 comes to rest between double indexes, the sealing cam 150 operates to close a switch 154 and thereafter holds the switch 154 closed for 210° of rotation of the sealing cam 150. In a like manner when the mount conveyor 24 comes to rest between indexes, the mount cam 152 closes a switch 156 and holds the switch 156 closed for 230° of rotation of the cam 152. The switches 156 and 154 are in series with air jet valve actuating solenoids 158, and therefore, it will be seen that the air jets 122 cannot operate unless both the mount conveyor 24 and the sealing conveyor 26 are at rest. In order to provide a safety factor for the prevention of the operation of the jets 122 immediately prior to motion of the sealing conveyor 26, the cams 150 and 152 are designed to open the switches 154 and 156 respectively, shortly before the start of indexing motion of either conveyor. In the case of the sealing conveyor 26, the sealing cam 150 opens the switch 154 .2 second before the sealing conveyor 26 commences indexing forward, and in the case of the mount conveyor 24, the cam 152 opens the switch 156 approximately .09 second prior to the start of the indexing motion of the mount conveyor 24. In Fig. 12 these short, so-called safety periods, are indicated by the small dotted-line portions at the respective ends of the periods of rest for each conveyor. Thus the switch 154 will be closed for a period of 1.4 seconds and the switch 156 for a period of .68 second, and the periods during which both switch 154 and 156 will be closed simultaneously are shown by the cross-hatched areas between the upper and lower lines. Of course, the air jets 122 can only operate when both switch 154 and switch 156 are closed.

Since there may already be a mount in a given mount holder 120 when a mount holder 48 indexes into position for transfer to that mount holder 120, and since the jets 122 must not operate at such times, we provide sensing switches 160 to detect the presence of mounts in the mount holders 120 in the transfer area 28. The sensing switches 160 are normally closed and mounts in the mount holders 120 serve to open the switches 160. Switches 160 are in series with the air jet valve solenoids 158 so that when mounts are present in the mount holders 120 in the transfer area 28, the respective air jets do not operate.

It will be appreciated, however, that in order to be sure that mounts will be fully transferred to the mount holders 120, the air jets 122 must not be cut off too abruptly after they have once started to transfer a mount across the gap between conveyors. For this purpose we provide time delay relays 162 in the circuits supplying current to air jet valve actuating solenoids 158. The relays 162 are actuated whenever a circuit through switches 156, 154, 160 and solenoids 158 is completed, and once a relay 162 is actuated it closes a switch 164 which is in a separate circuit for supplying current directly to the air jet valve solenoids 158. The relays 162 have a conventional time delay feature so that whenever the circuit through the switches 156, 154 and 160 is opened, the circuit through switches 164 directly from the source of power to the solenoids 158 remains closed for a short additional period. In practice, we have found that a delay period of .3 second for relays 162 is suitable. Thus, when a mount is transferred from a holder 48 to a holder 120 thereby opening a sensing switch 160, or when cams 150 or 152 open switches 154 or 156 respectively, the air blast at the appropriate air jet 122 will remain on for an additional .3 second. We find that in addition to insuring a complete transfer of mounts, the added air blast of .3 second also serves the beneficial function of preventing the mounts from bouncing back once they have arrived in the mount holders 120.

In this preferred embodiment of our invention we arrange the transfer area 28 with four mount holders 48 in registration with four mount holders 120, but it will be understood that our invention is not limited to any precise number of mount holders in the transfer area 28. In fact, many more mount holders could be thus arranged in alignment without departing from the spirit of our invention.

EXCESS MOUNT CONVEYOR

Since the mount holders 48 may well carry mounts 40 beyond the transfer area 28, we provide mechanism for transferring such excess mounts to the excess mount conveyor 30, shown in detail in Figs. 6, 8 and 11. The excess mount conveyor 30 comprises a chain conveyor 166,

in general, similar to the other chain conveyors herein described and carrying on it likewise similar mount holders 168. The chain conveyor 166 is driven by a sprocket 170, which is in turn driven by a pawl 172 (see Fig. 11) operating against a ratchet wheel 174 and being actuated by a tie rod 176 through an additional tie rod 178 deriving its actuating force from the drive mechanism for the mount conveyor 24. Thus the excess mount conveyor 30 operates in unison with the mount conveyor 24 when such is appropriate. However, there is no need to operate the excess mount conveyor 30 unless one of its holders 68 picks up a mount from the mount conveyor 24 and to accomplish this we arrange mount holders 168 of the excess mount conveyor 30 at a transfer area 180 in alignment with a mount holder 48 of the mount conveyor 24 at a point in the progression thereof subsequent to the passage of the mount holders 48 through the transfer area 28. A continuously operating air jet 182 is located adjacent to the transfer area 180 on the side of the mount conveyor 24, and whenever a mount is carried by a mount holder 48 into the transfer area 180, the mount is propelled acros the transfer area 180 to a mount holder 168. When the mount arrives in the mount holder 168, it actuates a sensing switch 184, which in turn brings about an indexing registration of the excess mount conveyor 30. In Fig. 14 we have shown the wiring diagram for this arrangement, and it will be seen that the sensing switch 184 is normally open. The presence of a mount in the mount holder 168 at the transfer area 180, closes the switch 184 and supplies current to a solenoid 186 (see also Fig. 11). The solenoid 186 operates through a link 190 and a rocker arm 192 to permit the pawl 172 to engage the ratchet wheel 174 and thereby effect an indexing registration for the excess mount conveyor 30. It will be noted that the sensing switch 184 remains in light contact with the mount for a substantial distance of the travel thereof between indexes of the mount conveyor 30 and in this way the solenoid 186 will not become de-energized prior to a full index of the excess mount conveyor 30. It should also be noted that the slightly widened portion at the base of the U-shaped mount holders employed herein holds the mounts in the respective holders against the outward force of sensing switch contacting elements.

Although not shown in detail as related to the excess mount conveyor 30, it will be understood that precise alignment of the mount holders 168 of the excess mount conveyor 30 is maintained by a spring loaded ball arrangement substantially the same as is shown in Fig. 1. Thus, the excess mount conveyor will only index forward whenever it receives a mount from the mount conveyor 24 and every excess mount on the mount conveyor 24 will be picked up by the excess mount conveyor 30.

STORAGE CONVEYOR

It will also be appreciated that the mount holders 120 of the sealing conveyor 26 may pass the transfer area 28 without having picked up a mount from the mount conveyor 24 and in order to be sure that all mount holders 120 of the sealing conveyor 26 are fully loaded prior to transfer of mounts to the sealing machine, we provide a storage conveyor indicated at 32 in Fig. 1. The storage conveyor 32 comprises a link chain arrangement indicated at 200 (see Fig. 6) carrying mount holders 202 of substantially the same construction as the chain conveyors and mount holders of other conveyors previously described. The storage conveyor 32 is arranged to provide a transfer area 204 adjacent to the sealing conveyor 26 at a point in the progress thereof subsequent to the transfer area 28, and mount holders 120 of the sealing conveyor are brought into precise alignment with holders 202 of the storage conveyor 32 by arrangements substantially similar to those previously described with regard to the transfer areas 28 and 180. Air jets 210 are appropriately located in registration with holders 202 at the transfer area 204 and serve to propel mounts across from the storage conveyor 32 to the sealing conveyor 26 when such a transfer is desired.

The drive mechanism for the storage conveyor 32 may be seen diagrammatically in Fig. 1 and consists in a tie rod 206 which is actuated each time the sealing conveyor 26 double indexes forward. The tie rod 206 operates through a drive wheel 208 to likewise double index the storage conveyor whenever such is appropirate. It will be understood, however, that the storage conveyor 32 need not index forward unless a transfer has taken place from the storage conveyor 32 to the sealing conveyor 26, and for this purpose we provide normally closed sensing switches 212 in position to detect the presence of a mount in holders 120 when they enter the transfer area 204. With reference to Figs. 6 and 15 it will be seen that air jets 210 are actuated by air jet valve solenoids 214 and that the circuits to solenoids 214 are closed only when switches 221 are closed by time delay relays 220, and the time delay relays 220 are only energized when both the sensing switches 212 and a cam-operated switch 216 are closed. The switch 216 is operated by a cam 218 which is driven rotationally in unison with the sealing cam 150 and makes a complete revolution for each double index of the sealing conveyor 26. The cam 218 closes the switch 216 only during the periods in which the sealing conveyor 26 is at rest. Thus when a mount is present in a mount holder 120 when it enters the transfer area 204, the appropriate sensing switch 212 will be opened and no air blast will issue from jet 210. On the other hand, if a mount holder 120 is vacant when it enters the transfer area 204, after the sealing conveyor 26 comes to rest, the switch 216 will be closed by the cam 218, and, since the sensing switch 212 will remain closed at that time, the appropriate relay 220 will be energized, the switch 221 will be closed and the circuit energizing the appropriate solenoid 214 will be completed with the result that an air blast will issue from the appropriate jet 210. Of course, this will then cause a mount to transfer from mount holder 202 to a mount holder 120.

Once a mount is transferred, the storage conveyor 32 will then have a vacant mount at the transfer area 204 and it will be necessary to double index the storage conveyor to bring forward loaded mount holders 202 into the transfer area 204 to take care of subsequent requirements of the sealing conveyor 26. This is accomplished also by the time delay relays 220 which also serve to close switches 222 either of which establish a circuit supplying current to a solenoid 224. The solenoid 224 serves to project a pin 226 upwardly through the drive wheel 208 to engage the drive mechanism of the storage conveyor 32 so that when the tie rod 206 is actuated by the drive mechanism of the sealing conveyor 26, the storage conveyor 32 will then double index to a new position. The time delay relays 220 are of conventional construction and provide a sufficient time delay to accomplish a full indexing of the storage conveyor 32 after the circuits through the solenoids 214 have been opened.

OPERATIONAL SUMMARY

It will now be seen that the operation of our invention is substantially as follows. The mount machine 20 and the mount conveyor 24 index from station to station in unison and mounts are transferred from the mount making machine 20 to the mount conveyor 24 one at a time, and as they issue from the mount making machine 20. The mounts are then carried around on the mount conveyor 24 to the transfer area 28 where they are transferred from the single indexing mount conveyor 24 to the double indexing sealing conveyor 26 by operation of air jets 122. However, since the mount holders 120 of the sealing conveyor are not necessarily all loaded with mounts in the transfer area 28, any vacancies therein are

filled from the storage conveyor 32 at the transfer area 204. In this way we satisfy the entire input requirements for the sealing machine 22. On the other hand, any mounts that are carried on the mount conveyor 24 beyond the transfer area 28 are picked up at the transfer area 180 by the excess mount conveyor 30. The excess mount conveyor 30 carries mounts along in a position adjacent to one side of the storage conveyor 32 where they may be rapidly and conveniently transferred from the excess mount conveyor 30 to the storage conveyor 32 by hand. It will be understood, of course, that the transfer from the excess mount conveyor 30 to the storage conveyor 32 may be effected mechanically without departing from the spirit of our invention.

Since numerous minor variations of this preferred embodiment of our invention will now be apparent to those skilled in the art, it is not our intention to confine this invention to the precise form herein shown, but rather to limit it in terms of the appended claims.

Having thus described and disclosed a preferred embodiment of our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In apparatus for transferring articles from a first machine to a second machine wherein the rate of output of said articles from said first machine fluctuates while the input rate of said articles into said second machine remains relatively constant, having in combination, a first conveyor, holders for said articles spaced and arranged in sequence along said conveyor, means for transferring said articles from said first machine to said holders, a second conveyor, holders for said articles spaced and arranged in sequence along said second conveyor, said first and second conveyors having a portion of each in juxtaposition with said holders in alignment at a transfer area, means at said transfer area for transferring said articles from the holders on said first conveyor to the holders on said second conveyor, means for storing any articles carried by said first conveyor beyond said transfer area, an auxiliary supply means for said articles, means for transferring said articles in said auxiliary supply means to any holder on said second conveyor which may have passed said transfer area without having received a said article.

2. In apparatus for transferring lamp parts from one machine to another in the process of making lamps, the combination of, a first conveyor, a second conveyor, part holders on each conveyor arranged in line and spaced apart equally, a portion of each conveyor lying adjacent to a portion of the other with a plurality of holders of each in opposed relation at a transfer area, means for indexing each conveyor ahead intermittently at different speeds and for bringing holders on each conveyor successively to rest in registration with holders of the other at said transfer area, means for propelling a said part from a holder on said first conveyor to a holder on said second conveyor, means for sensing the presence of a said part in the holders of said second conveyor when they are in said transfer area, means for timing the dwell period of each of said conveyors, and means for actuating said part propelling means, said actuating means being controlled by said sensing means and said timing means whereby a part will be propelled from a holder on said first conveyor to a holder on said second conveyor only when said holders are at rest at said transfer area, a holder on said second conveyor does not have a said part and the remaining time of the dwell periods of each of said conveyors is long enough to permit the transfer of a said part from a holder on said first conveyor to a holder on said second conveyor.

3. In apparatus for transferring lamp mounts from a mount making machine to a sealing machine in the process of making lamps, comprising, a mount conveyor, a sealing conveyor, an excess mount conveyor, a storage conveyor, mount holders on each said conveyor arranged in line and spaced apart equally, a portion of said mount conveyor lying adjacent to said sealing conveyor with the holders of each in opposed relation at a first transfer area, a portion of said excess mount conveyor lying adjacent to said mount conveyor with a holder on each in opposed relation at a second transfer area, said storage conveyor lying adjacent to said sealing conveyor with holders of each in opposed relation at a third transfer area, a portion of said excess mount conveyor lying adjacent to a portion of said storage conveyor, means for transferring mounts from said mount conveyor to said sealing conveyor at said first transfer area, means for transferring mounts from said mount conveyor to said excess mount conveyor at said second transfer area, and means for transferring mounts from said storage conveyor to said sealing conveyor at said third transfer area.

4. Apparatus for transferring lamp mounts defined in claim 3 further characterized by means for sensing the presence of a mount in a mount holder of said sealing conveyor at said first and third transfer areas, and means for actuating said transfer means at said first and third transfer areas only when a holder on said sealing conveyor at said first and third transfer area is not occupied by a mount.

5. The apparatus for transferring lamp mounts defined in claim 3 further characterized by means for sensing the presence of a mount in a holder on said sealing conveyor at said third transfer area and means for indexing said storage conveyor ahead only when a transfer from a holder on said storage conveyor to a holder on said sealing conveyor has taken place.

6. The apparatus for transferring lamp mounts defined in claim 3 further characterized by means for indexing said mount conveyor ahead intermittently by a distance equal to the spacing between centers of the holders mounted thereon, and means for indexing said sealing conveyor ahead intermittently by a distance equal to twice the distance between centers on holders on said sealing conveyor.

7. Apparatus for transferring lamp mounts from a mount making machine to a sealing machine in the process of making lamps, comprising, a mount conveyor, a sealing conveyor, an excess mount conveyor, a storage conveyor, mount holders on each said conveyor arranged in line and spaced apart equally, a portion of said mount conveyor lying adjacent to said sealing conveyor with the holders of each in opposed relation at a first transfer area, a portion of said excess mount conveyor lying adjacent to said mount conveyor with a holder on each in opposed relation at a second transfer area, said storage conveyor lying adjacent to said sealing conveyor with holders of each in opposed relation at a third transfer area, a portion of said excess mount conveyor lying adjacent to a portion of said storage conveyor, means for transferring mounts from said mount conveyor to said sealing conveyor at said first transfer area, means for transferring mounts from said mount conveyor to said excess mount conveyor at said second transfer area, means for transferring mounts from said storage conveyor to said sealing conveyor at said third transfer area, means for single indexing said mount conveyor, means for double indexing said sealing conveyor, and means for limiting the start of operation of said transfer means at said first transfer area to a substantial time interval before the indexing motion of either the mount conveyor or the sealing conveyor takes place.

8. The combination of claim 2 and an excess mount conveyor, a portion of which is disposed adjacent to said first conveyor beyond said transfer area, and means for transferring a said part from a holder on said first conveyor to said excess mount conveyor.

9. The combination of claim 2 and a storage conveyor, a portion of which is disposed adjacent to said second conveyor beyond said transfer area, and means for transferring a said part from said storage conveyor to a holder on said second conveyor.

10. The combination of claim 2 and an excess mount conveyor, a portion of which is disposed adjacent to said first conveyor beyond said transfer area, means for transferring a said part from a holder on said first conveyor to said excess mount conveyor, a storage conveyor, a portion of which is disposed adjacent to said second conveyor beyond said transfer area, and means for transferring a said part from said storage conveyor to a holder on said second conveyor.

11. In apparatus for transferring lamp parts from one machine to another in the process of making lamps, comprising, a first conveyor, a second conveyor, part holders on each conveyor arranged in line and spaced apart equally, means to transfer said parts from one said machine to holders on said first conveyor, a portion of each conveyor lying adjacent to a portion of the other with a plurality of holders of each in opposed relation at a first transfer area, means for indexing each conveyor ahead intermittently and for bringing holders on each conveyor successively to rest in registration with holders of the other at said transfer area, means for transferring a part from a holder on said first conveyor to a holder on said second conveyor only at said transfer area with said holders in registration and only at times when the said holder on said second conveyor does not contain a said part, means for storing any said part remaining on a holder of said first conveyor after passing through said transfer area, said storage means including an excess part conveyor, holders on said excess part conveyor, a portion of said excess part conveyor lying adjacent to a portion of said first conveyor with a holder of said excess part conveyor in opposed relation to a holder of said first conveyor at a second transfer area located at a station subsequent in the progression of said first conveyor to the transfer area between said first and second conveyors, and means for transferring a said part from a holder on said first conveyor to a holder on said excess part conveyor only at said second transfer area with said holders in registration, means for indexing said excess part conveyor ahead intermittently in unison with said first conveyor but only at times when a said part is transferred from said first conveyor to said excess part conveyor, a storage conveyor, part holders on said storage conveyor, said storage conveyor being positioned adjacent to said excess part conveyor along one portion thereof and adjacent to said second conveyor along another portion thereof at a third transfer area, and means at said third transfer area for transferring said parts from said storage conveyor to said second conveyor whenever a part holder on said second conveyor enters said third transfer area without containing a said part.

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