United States Patent

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[54] **MATERIAL HANDING APPARATUS**
8 Claims, 15 Drawing Figs.

[52] U.S. Cl. 198/19, 246/122, 214/86
[51] Int. Cl. B23q 5/22
[50] Field of Search .... 198/19; 214/89, 86, 16 B; 212/123, 124, 125, 126; 246/122 R

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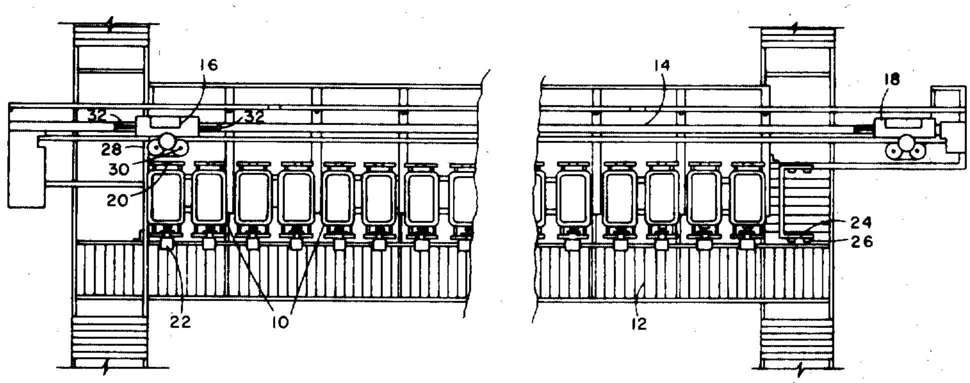
ABSTRACT: Material handling apparatus of the conveyor type especially suited for computer controlled operation. Mechanical features and electronic control features including safety precautions are described in a printed circuit processing application.



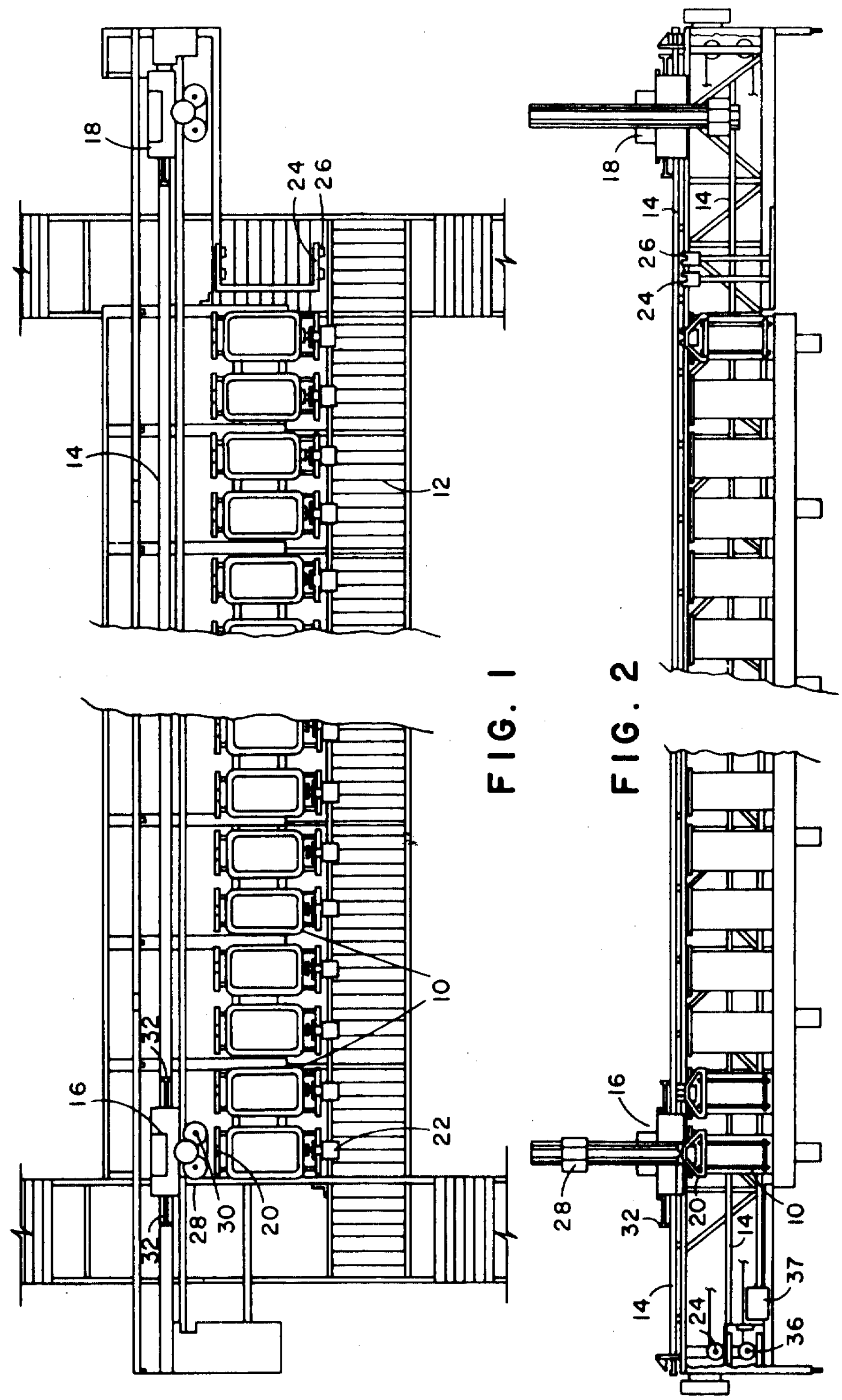


FIG. 1

FIG. 2

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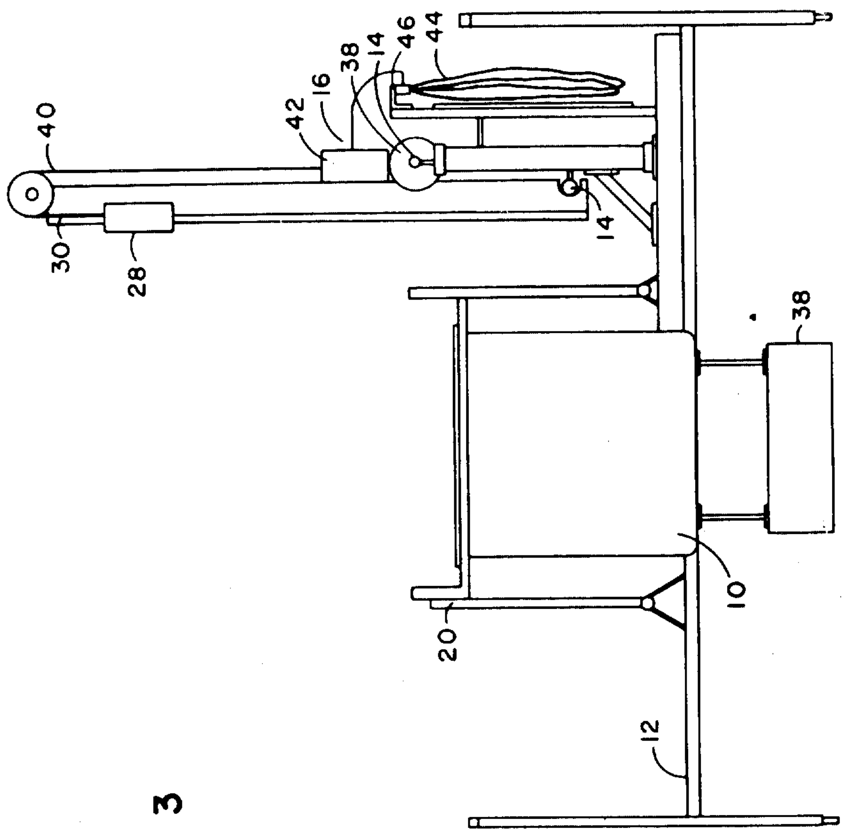

FIG. 3

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FIG. 5

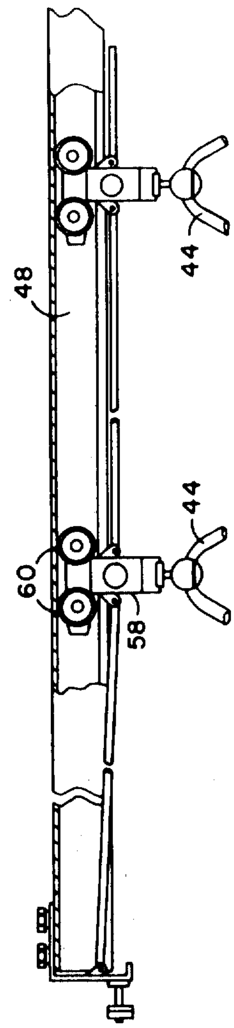
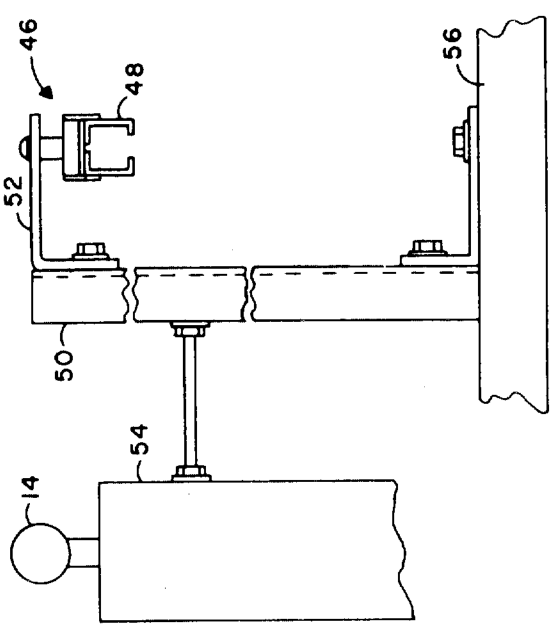


FIG. 4



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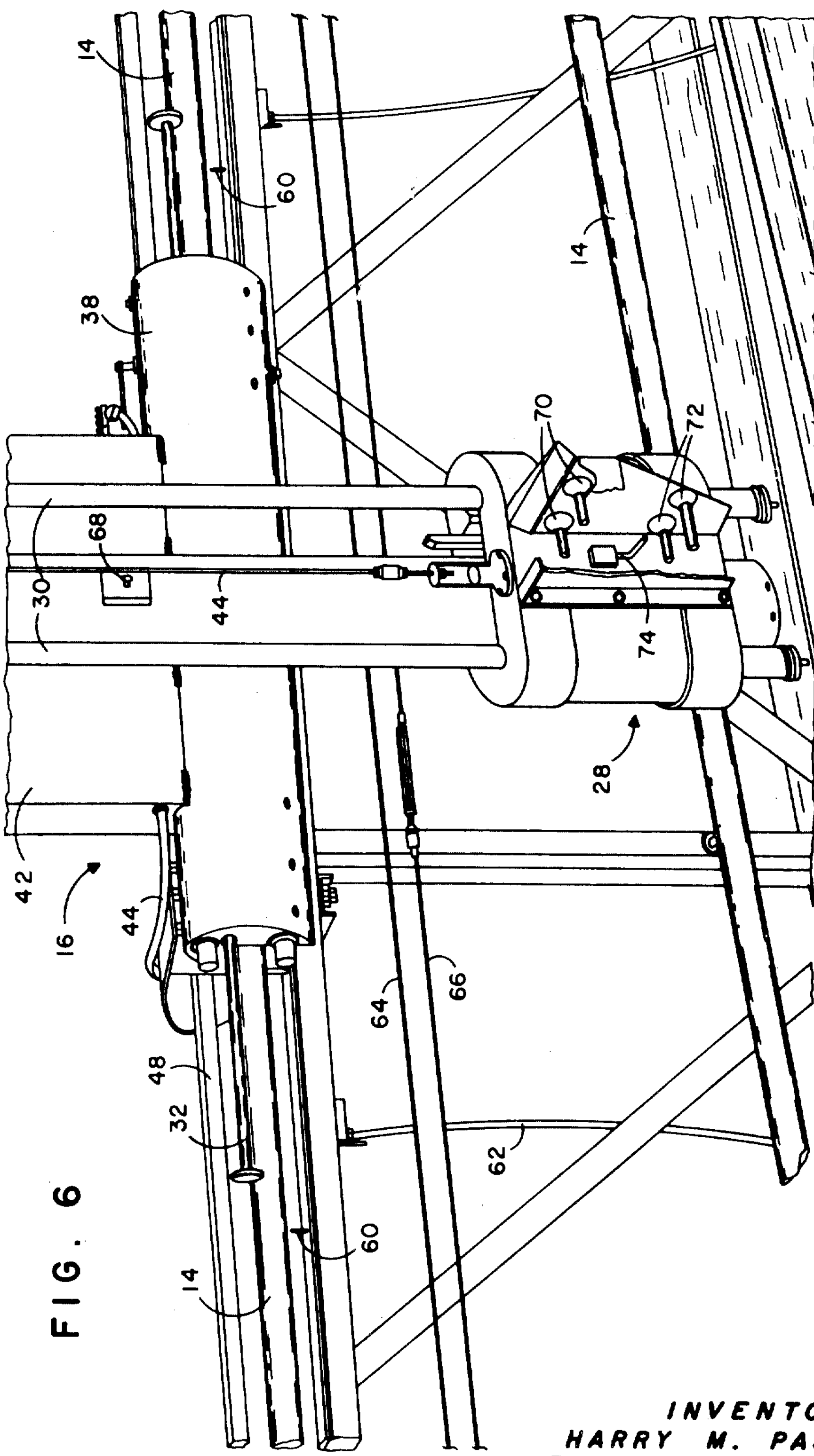

FIG. 6

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FIG. 7

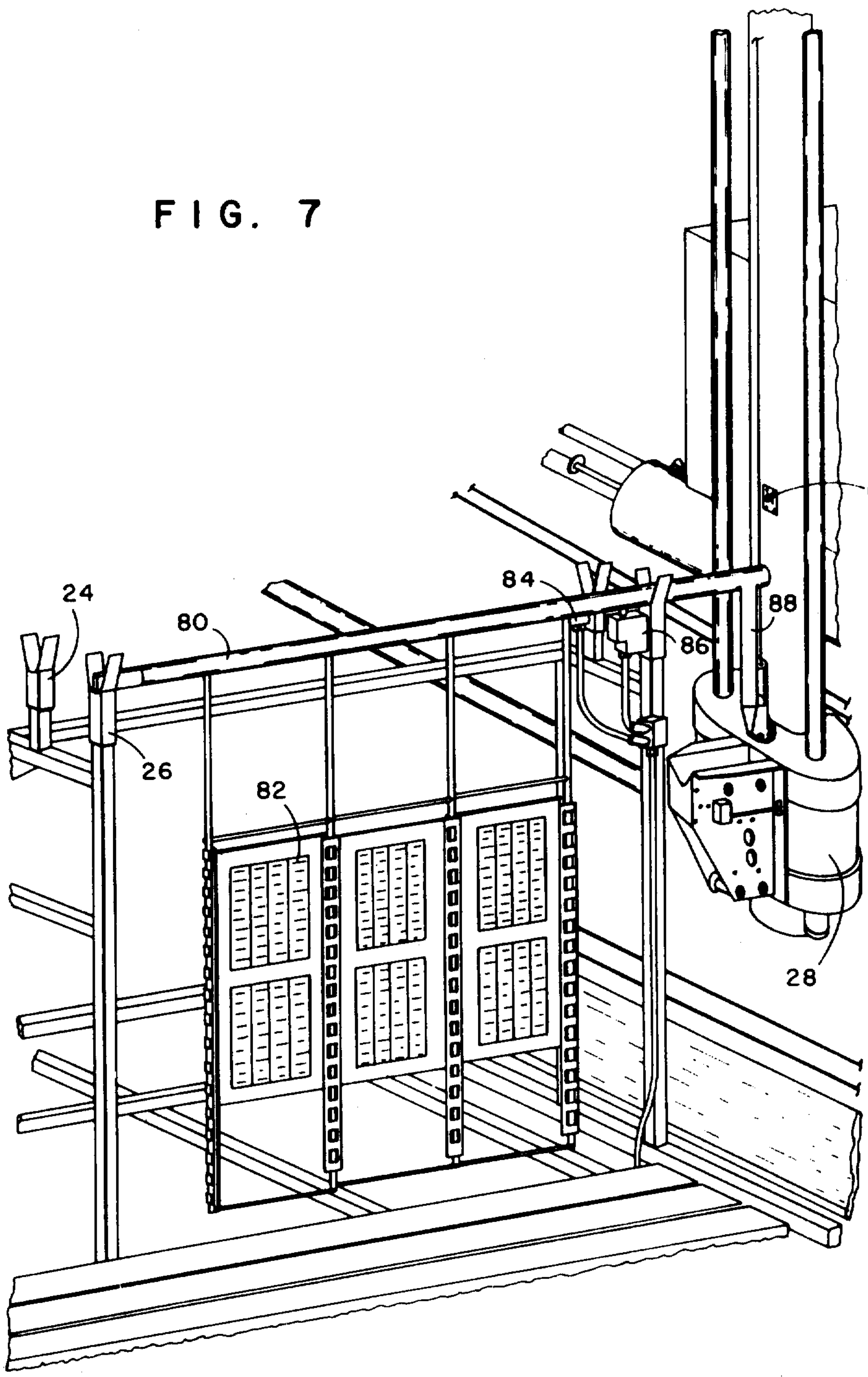

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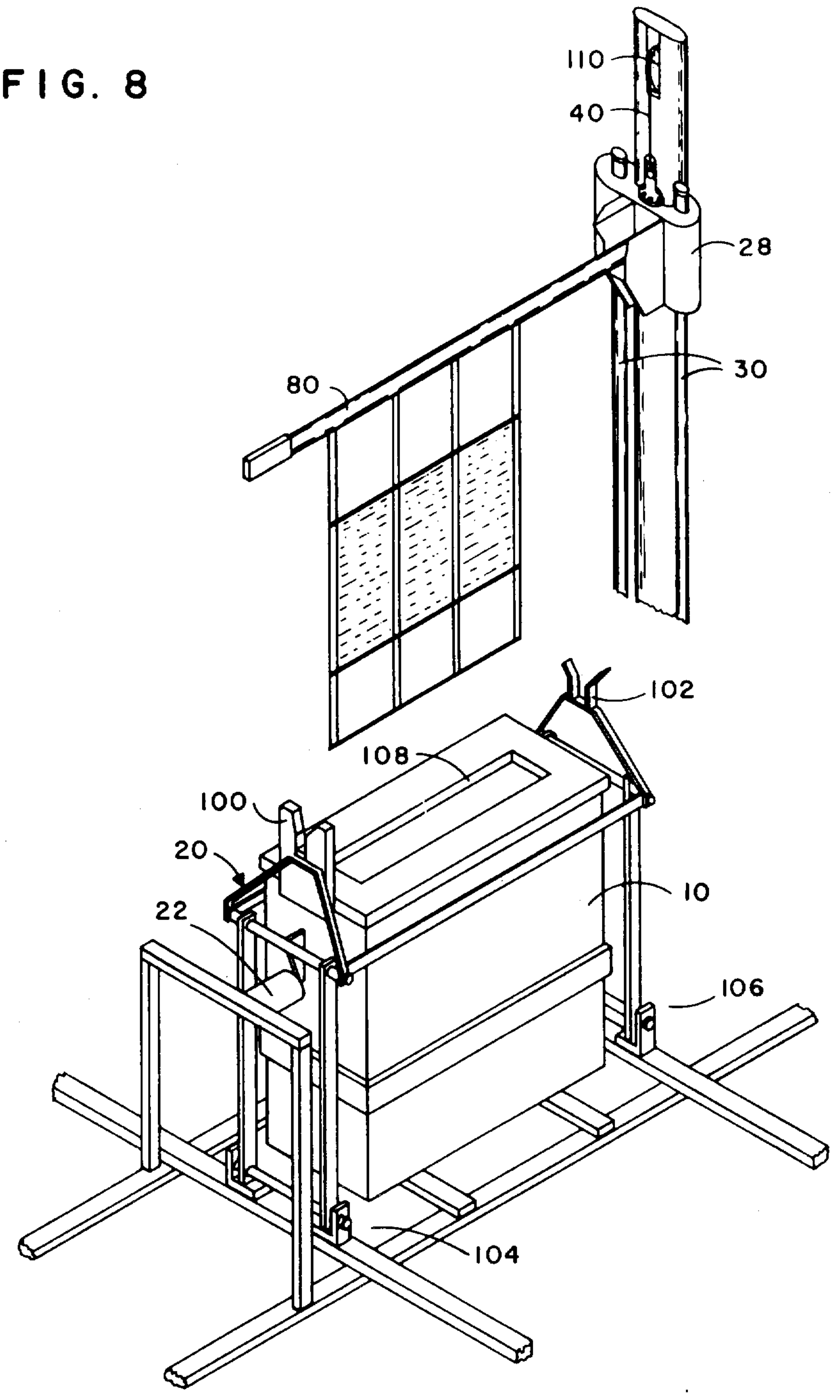
FIG. 8



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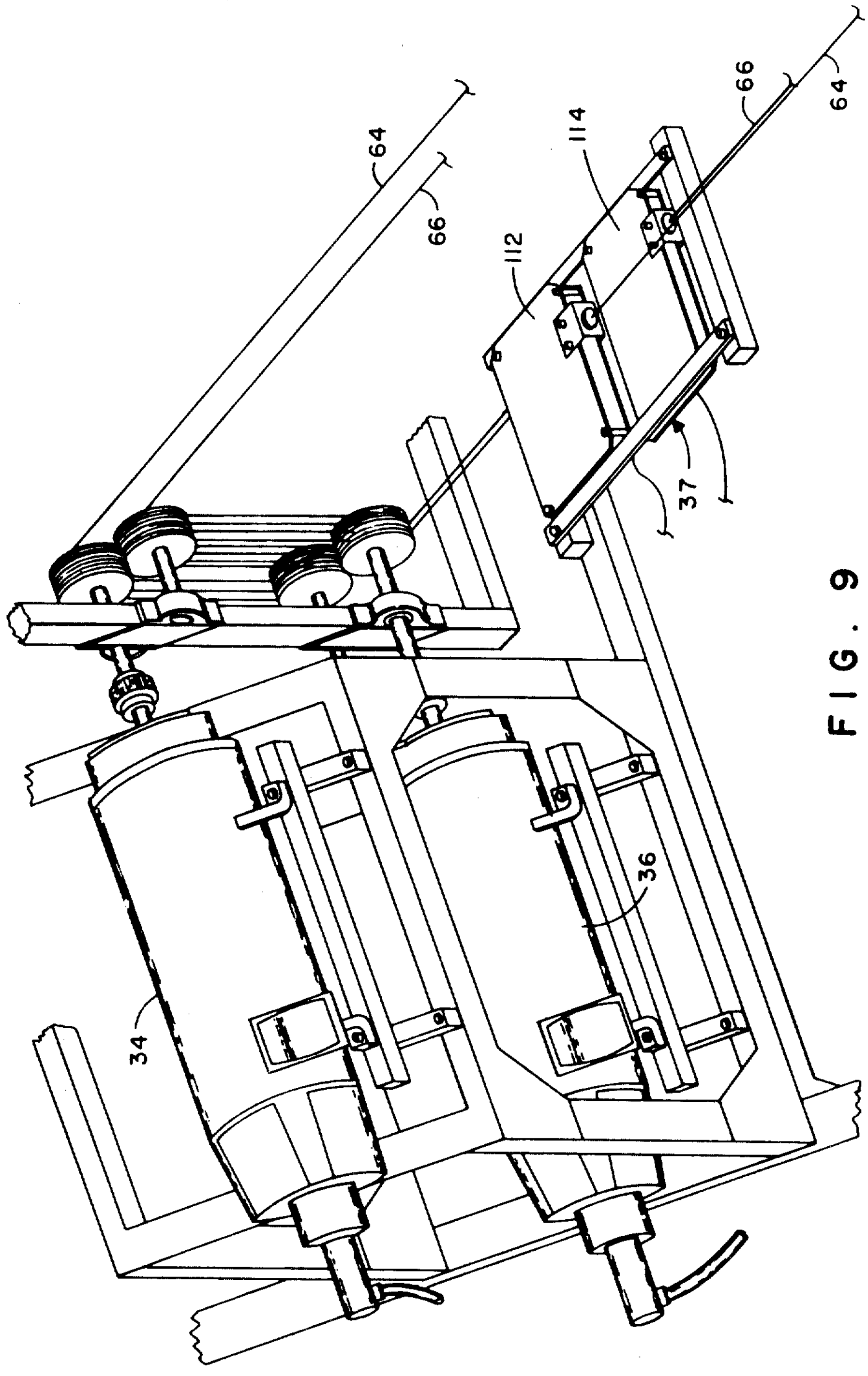

FIG. 9

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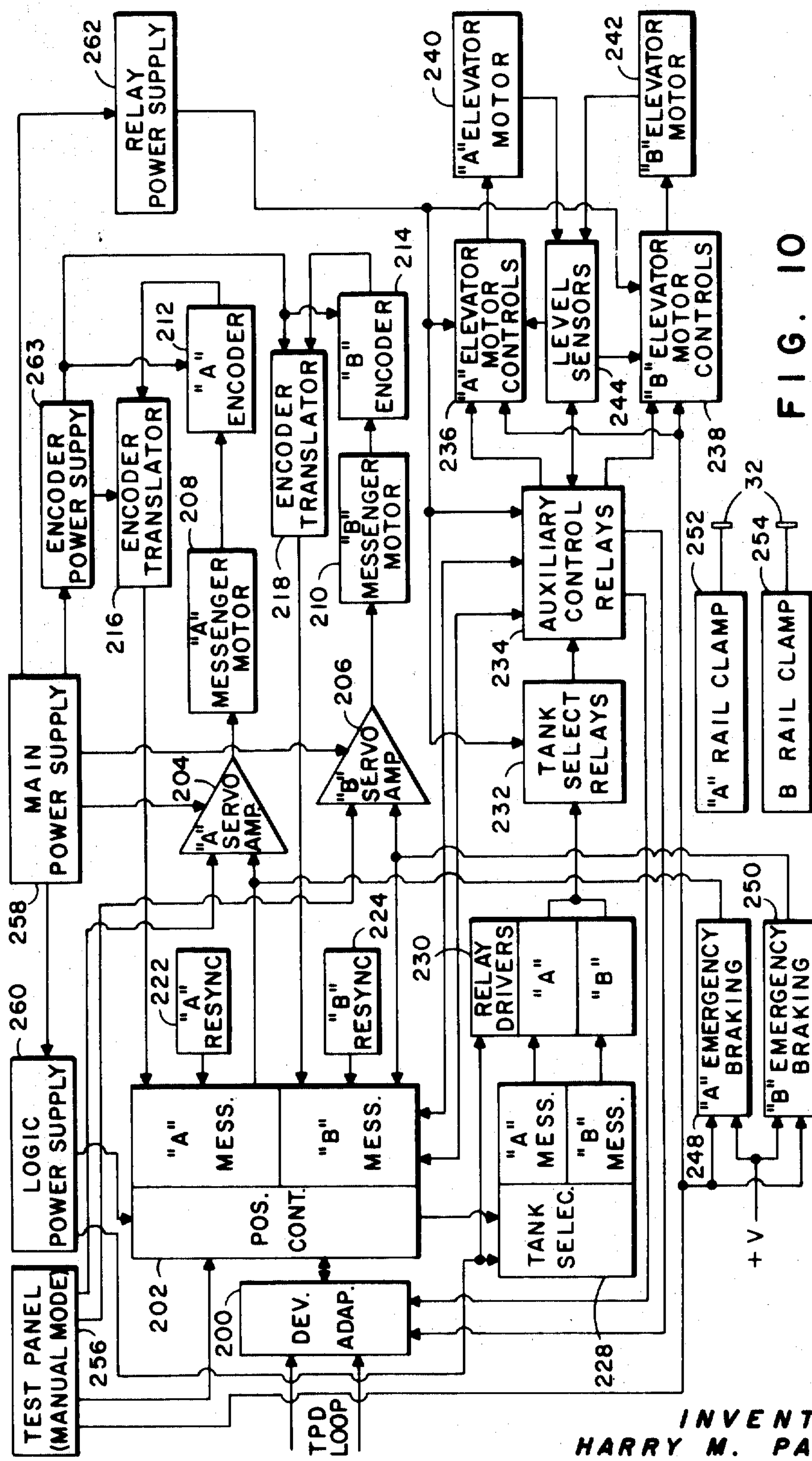

FIG. 10

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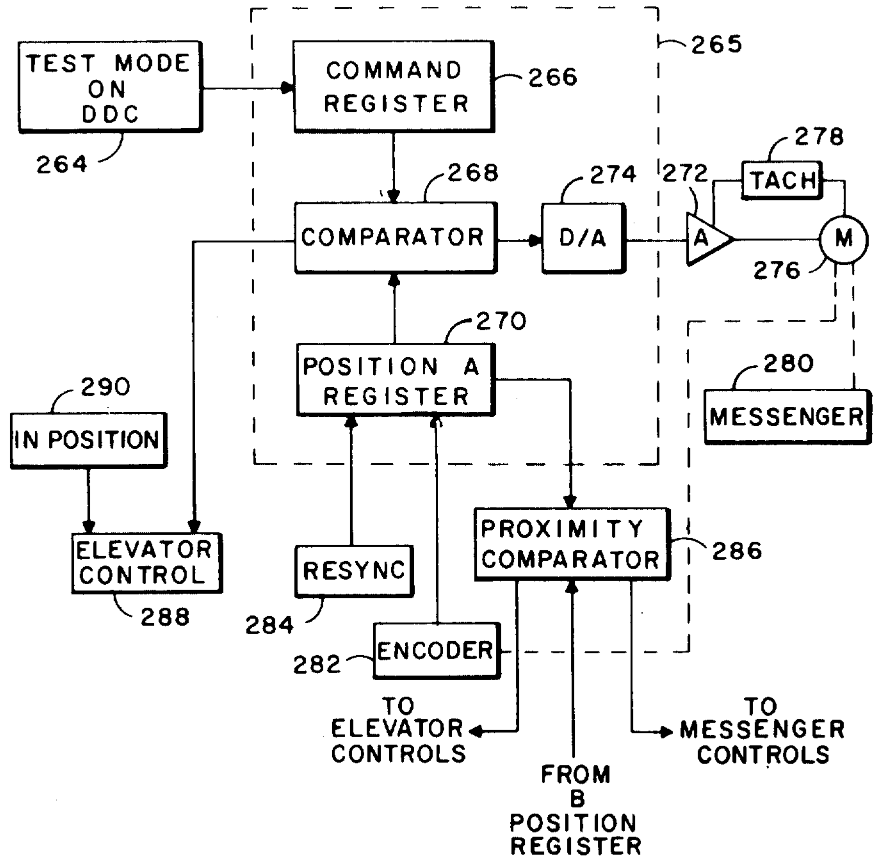

FIG. 11

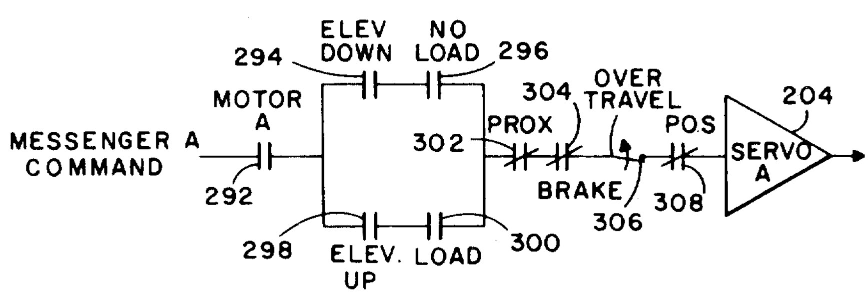

FIG. 12

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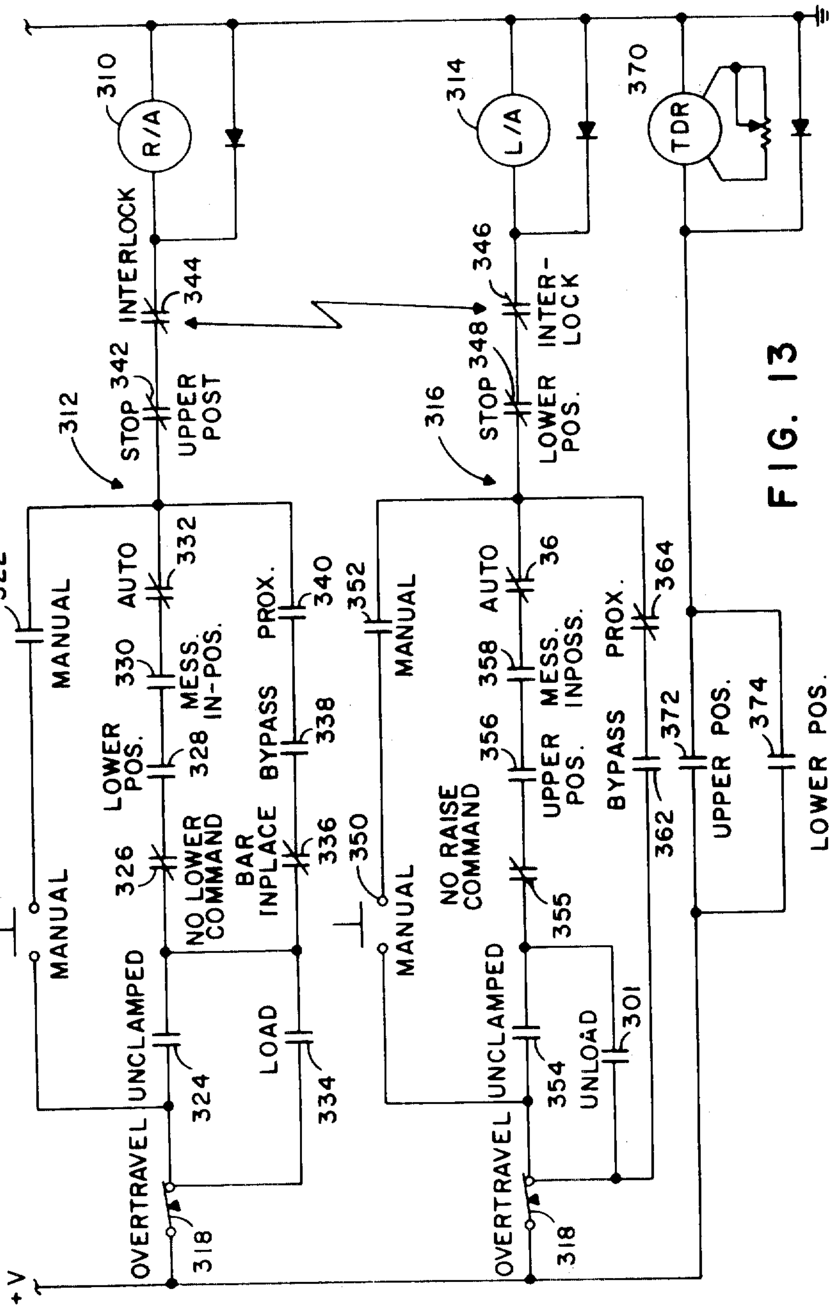

FIG. 13

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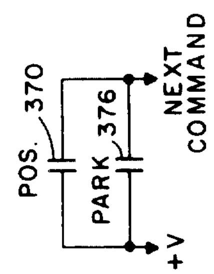

FIG. 14

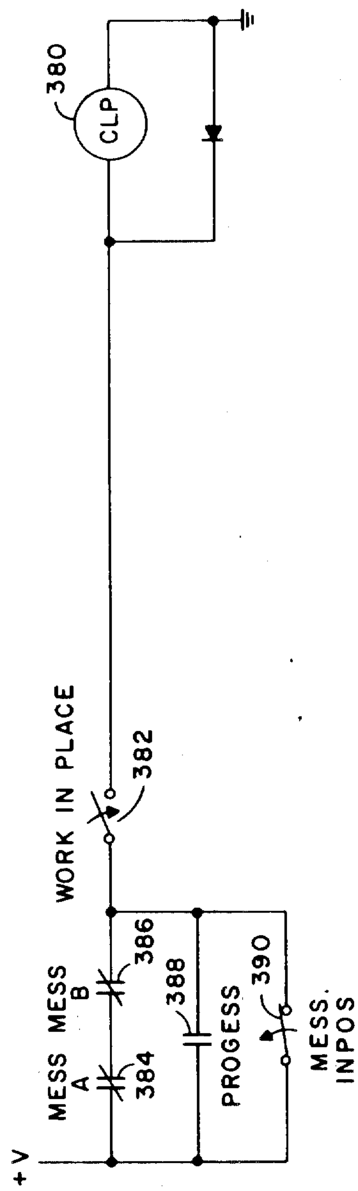

FIG. 15

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MATERIAL HANDING APPARATUS

This invention relates generally to material handling apparatus, and more particularly to material handling apparatus of the conveyor type which is especially suited for computer controlled operation. One example use of such apparatus is in the processing of printed electronic circuits, and the invention will be described with respect to this application. However, it is to be appreciated that other material handling applications are feasible and within the scope of the invention.

In the processing of printed circuit boards, blanks or unprocessed boards undergo a number of chemical processing steps including cleaning, electrolysis copper deposition, photoresist masking, copper, tin and tin-lead electroplating titnating, resist stripping, and other chemical etching to define desired circuit patterns. The process readily lends itself to a continuous process flow with conveyor means for facilitating transfer of boards from one process station to the next process station.

Several plating conveyors have been suggested and/or manufactured, but all known systems have structural disadvantages and do not lend themselves to automatic, computer control.

An object of the present invention is an improved material handling apparatus of the conveyor type.

Another object of the invention is improved material handling apparatus which is adaptable to the process of printed electronic circuits.

Still another object of the invention is improved material handling apparatus which is suited for computed controlled operation.

Yet another object of the invention is a printed circuit production system including conveyor means which may be automatically, computer controlled.

Another object of the invention is improved material handling apparatus for printed electronic circuit fabrication which is flexible in operation and which has no structural parts other than board support means moving over process tanks.

Briefly, in a printed circuit processing application the present invention includes a plurality of process tanks in a sequentially spaced arrangement, board support means, each tank having an opening for receiving said board support means, each board support means including a lift member extending beyond the periphery of a process tank when the support means is positioned within the tank. A rail support and travel system is provided with each line of tanks, and one or more lateral transfer means, or messengers, including elevator means for removing or inserting board support means into and out of each tank is provided which travels on the rail support system. The drive means and control means for the messengers is designed to allow either a manual test or computer control mode of operation.

The invention and objects and features thereof will be more fully understood from the following detailed description and appended claims when taken with the drawings, in which:

FIG. 1 is a top view of a conveyor system in accordance with the present invention;

FIG. 2 is a side view of the conveyor system of FIG. 1;

FIG. 3 is a side view of a messenger taken along the line of lateral movement of a messenger;

FIG. 4 is a side view of the support means for the messenger cable for power and logic circuits;

FIG. 5 is a section view of the support means in FIG. 4 including moveable cable support members;

FIG. 6 is an isometric view of the messenger and elevator means;

FIG. 7 is an isometric view of a messenger, work support means, and load and unload stations;

FIG. 8 is an isometric view of a process tank, agitator and messenger;

FIG. 9 is an isometric view of the messenger drive means and encoder;

FIG. 10 is a functional block diagram of the messenger control system;

FIG. 11 is a functional block diagram of the controller portion of the messenger control system of FIG. 10;

FIG. 12 is a schematic of the messenger control relays;

FIG. 13 is a schematic of elevator control relays;

FIG. 14 is a schematic of controller address means of each elevator; and

FIG. 15 is a schematic of work station clamp control relays.

Referring now to the drawings, FIG. 1 is a top view of a conveyor system in accordance with the present invention adapted for the production of printed circuit boards. A plurality of processing tanks 10 are serially arranged for carrying out the rinsing, plating and etching steps in printed circuit fabrication. A walkway 12 is provided along one side of the tanks for human operators, and a horizontal rail assembly 14 comprising two parallel, vertically spaced rails is provided along the other side of the tanks. Two lateral transfer messengers 16 and 18 are provided which travel along horizontal rail 14 for transferring workpieces between the various process tanks. Only one such messenger is necessary in the conveyor system, however, a preferred embodiment includes two such messengers which may operate along the rail simultaneously. Various safety features are incorporated to prevent collisions, as will be described further below.

Referring again to the tanks 10, it will be noted that at either end of the tank, support means 20 is provided for receiving a work support member (not shown in this view). Reciprocating pneumatic cylinders 22 are activated upon receipt of a work support assembly to provide agitation of workpieces within each tank during a processing operation. The agitator assembly will be further described below with reference to FIG. 8. At one end of the line of tanks a load station 24 and an unload station 26 are provided for loading and unloading the work support assemblies.

The messengers 16 and 18 are provided with elevators 28 which lower and raise workpieces into and out of the process tanks. The elevators travel along a vertical rail assembly comprising a pair of vertical rails 30 which are a part of the messenger. Arms 32 extend from either end of messenger 16 for initiating a safety brake and absorbing impact should the messenger be involved in a collision due to control means failure.

FIG. 2 is a side view of the conveyor system shown in FIG. 1 and further illustrates the agitator support assembly 20 of the tanks 10, the load and unload stations 24 and 26, respectively, and the messengers 16 and 18. It will further be noted that the horizontal travel rail assembly includes an upper rail and a lower rail, both designated 14, along which the messengers travel. As will be described further below, the elevators 28 for each messenger may assume one of three positions, namely a lower unloaded position as assumed by the elevator of messenger 18, an upper loaded position as assumed by the elevator of messenger 16, and an intermediate position at which the workpieces are loaded and unloaded. Control means to be described further below allows a messenger to move along the horizontal travel rails 14 only when the messenger elevator is unloaded and in the lower position or loaded and in the upper position.

The two messengers are driven independently by cable drive means including servo-controlled motors 34 and 36 located at one end of the conveyor line. An encoder 37 is provided which senses the movement of the drive cables and thereby indicates digitally the movement and position of the messengers. The servo-controlled motors and encoder will be further described below with reference to FIG. 9 and the control system shown in FIG. 10.

FIG. 3 is a side section view taken along the axis of the lateral rail assembly and further illustrates the relationship of the messenger and a process tank. The walkway 12 is on one side of tank 10 and the messenger 16 and horizontal travel rails 14 are on the opposite side of the tank. The agitator support 20 is pivotally mounted to permit lateral movement when activated by reciprocating pneumatic cylinder.

An upper messenger housing 38 includes bearings for riding an upper rail 14 and further includes brake means for use in emergency stops. The lower rail 14 is engaged by the messenger in a manner to support the messenger assembly upright and counteract the movement force when the elevator 28 is supporting a load. Movement of elevator 28 along rail 30 is provided by means of cable 40 and drive means 42, which are further described below.

Power to the elevator drive motor 42 is provided by means of cable 44. Cable 44 is accommodated by support 46 so that the cable may be extended as the messenger moves along the rail assembly 14 thereby maintaining power to the elevator drive 40. The support 46, as further illustrated in FIG. 4, includes a channel 48 having a bottom opening which is supported in spaced relationship with respect to member 50 by means of a bracket 52. Member 50 is mounted to support member 54 for upper rail 14 and bottom support member 56.

FIG. 5 is a section view of channel 48 and illustrates cable support carriers 58 which include rollers 60 which provide movement for the carriers 58 along the channel 48. Thus, as a messenger moves along the rail assembly, cable 44 for the elevator drive is extended by means of the cable carrier 58 movement along channel 48.

FIG. 6 is an isometric view which further illustrates details of the messenger, elevator and rail assemblies. As the messenger 16 moves along upper rail 14, photoelectric detector means within upper messenger housing 38 senses pins 60 which are provided along the rail assembly, and the electrical pulse is transmitted to the messenger control system to resync the indicated messenger position. These resync signals are necessary to correct possible errors from cable driven encoder 37. Cable 62 is associated with tank position sensing means and transmits an in-position signal to the controller when a messenger arrives at the tank position. Cables 64 and 66 which provide movement of the messengers along rail assembly 14 also drive the encoder 37 as described above with reference to FIG. 2.

As described above, elevator 28 may assume one of three positions as it moves along vertical rails 30, namely a lower unloaded position (as shown in FIG. 6), an upper loaded position (not shown in FIG. 6), and an intermediate position for receiving or discharging a load. At each one of these positions a microswitch is provided to generate a signal indicative of the elevator being at the respective position. Microswitch 68 is shown for indicating the intermediate position at which loads are received and discharged by the elevator. Importance of these position indicating switches will be appreciated from the description of the messenger control system, below.

Elevator 28 is driven by means of cable 44 and a drive motor within housing 42. As described above with reference to FIGS. 3–5, the elevator drive motor receives its power through cable 44 which is supported by channel 48.

The load receiving portion of elevator 28 is shown in a partially cutaway view and includes an upper pair of rollers 70 and a lower pair of rollers 72 which receive a pin member of the work support means, described below with reference to FIG. 7. When the pin member is in position within elevator 28, microswitch 74 is tripped and a load-in-position message is transmitted to the messenger control system.

FIG. 7 is an isometric view of a work holder 80 including a plurality of printed circuit boards 82 arranged and supported thereby to facilitate chemical processing. The work holder 80 is shown in the unload position 26 with the load position 24 adjacent thereto. Associated with load and unload positions 24 and 26 are microswitches 84 and 86, respectively, which are actuated when a work holder is in position in the load or unload stations. Associated with each tank or work station is a microswitch similar to switches 84 and 86 which indicates the presence of a work holder in the tank. Extending downwardly from work holder 80 is a rod 88 which is received by elevator 28 when the work holder is to be elevated, as described above with reference to FIG. 6. In this figure the elevator 28 is shown in the down position ready to receive pin 88 and work holder 80 upon raising of the elevator.

An isometric view of a tank 10 and associated agitator means is shown in FIG. 8 along with a work holder 80 supported by elevator 28 and positioned for insertion into process tank 10. The agitator support 20 includes members 100 and 102 at either end of the tank for receiving the work holder 80 as the elevator is lowered. A microswitch is associated with member 100 which is tripped upon the positioning of work holder 80 in the agitator support and thereby providing a work-in-place signal to the control means. Agitator support 20 is pivotally mounted as shown at 104 and 106 thereby permitting lateral movement of the agitator support when cylinder 22 is actuated. Tank 10 includes an opening 108 in its top surface for receiving the protruding portion of work holder 80 as elevator 28 is lowered. Connected with elevator 28 is cable 40 which passes over a pulley 110 mounted in the upper elevator structure and is driven by the elevator drive means 42 (shown in FIG. 6).

The drive means and encoders for the two messengers are shown in FIG. 9. Cables 64 and 66 which are connected to the two messengers are driven respectively by servomotors 34 and 36. Power to the two servomotors is provided by suitable SCR amplifiers such as General Electric's VI SCR amplifier. Position indication for the two messengers is provided by encoder means 37 which comprises two incremental digital encoders 112 and 114 each of which is driven by either cable 64 or cable 66. Commercially available encoders such as the Model 834 optical encoder manufactured by Disc Instruments, Inc. may be utilized for the encoders 112 and 114. By mounting a 6.6-inch diameter sheave on the encoder, 200 pulses per revolution will result in a pulse for every 0.1056 inch of cable traveled. Because of slippage and runout problems connected with driving the encoder from a sheave driver by the drive cable, the index transducers 60 (shown in FIG. 6) are provided to correct errors in position by resyncing the position indicator in the control means, as further described below.

The control means for the conveyor will now be described with reference to FIGS. 10–15. Referring to FIG. 10, a functional block diagram of the entire control means is illustrated. In computer operations, program control is effected through the Time Division Multiplexed (TDM) loop to the input device adapter 200. Device adapter 200 stores incoming instructions and feeds command information in compatible form to position controller 202 and feeds back information to the computer. In response to command inputs, position controller 202 through messenger command portions for a messenger "A" and a messenger "B," controls the servoamplifiers 204 and 206 which in turn drive "A" messenger motor 208 and "B" messenger motor 210, respectively. When driving the two messengers, messenger motors 208 and 210 drive "A" encoder 212 and "B" encoder 214, as described above with reference to FIG. 9, which provide messenger position information through encoder translators 216 and 218 back to the position controller 202.

Associated with the rail assembly are the "A" resync transducers 222 and "B" resync transducers 224 which provide corrections to the "A" messenger and "B" messenger position registers which may be required due to slippage and runout problems connected with driving the encoders 212 and 214.

Associated with the position controller 202 is tank selection decoding and comparison means 228 which controls the operations at each work station tank through means of relay drivers 230 and tank select relays 232. Auxiliary control relays 234 provide feedback to the computer loop to indicate when a messenger and a tank processing cycle is completed. The auxiliary relays 234, which provides inputs to the "A" elevator motor control 236 and "B" elevator motor control 238, incorporates safety features for safely controlling "A" elevator motor 240 and "B" elevator motor 242, as described further below with respect to FIGS. 12–15. Level sensors 244 including microswitches at the three stationary elevator positions (lower unloaded position, intermediate load/unload position, and upper loaded position) provide inputs to the elevator controls 236 and 238 and auxiliary control 234.

Position controller **202** is programmed to provide emergency braking should the indicated "A" messenger and "B" messenger positions approach each other below a prescribed minimum. In such a situation, the servoamplifiers **204** and **206** are deactuated, armature excitation is removed from the drive motors, and the resulting generator behavior of the motors provides dynamic braking. Additionally, should the messenger approach each other and arms **32** engage, "A" rail clamp **252** and "B" rail clamp **254** are mechanically actuated.

Test panel **256** is provided for a manual mode operation of the conveyor system. Inputs to elevator controls **236** and **238**, emergency braking **248** and **250**, position controller **202**, and servoamplifiers **204** and **206** are provided from the test panel **256** to effect the manual mode operation.

Power for the system is provided by a main power supply **258** which may typically be 460 volts, 3 phase AC for compatibility with the servoamplifiers. Logic power supply **260**, typically +5 volts DC, and relay power supply **262**, typically 24 volts DC and encoder power supply **263** are provided in cooperation with the main power supply **258**.

The "A" messenger control portion of the position controller **202** is illustrated within block **265** in FIG. **11**. Command inputs from the test mode or computer **264** are fed to a command register **266** in the position controller. In response to the received command, comparator **268** compares the command register position with the indicated position "A" register **270** and in response thereto provides an input to the servoamplifier **272** through digital-to-analog converter **274**. Amplifier **272** energizes "A" messenger motor **276** which in turn drives the messenger to the command position. Tachometer **278** provides feedback to the amplifier **272** and thereby governs the motor speed. Motor **276** also drives encoder **282** which updates position "A" register **270**. Also, as above described, resync transducers **284** function to correct any errors in the position "A" register caused by cable slippage, for example, as the messenger is moved along the track.

As a safety feature proximity comparator **286** is provided to measure the relative proximity of the two messengers and stop messenger operation upon the distance between the two messengers dropping below a prescribed minimum. Inputs are received by proximity comparator **286** from the position "A" register **270** and from the "B" position register, and control signals are provided to stop operation of the elevators and the messengers upon the indication of an imminent collision.

After a command is received by the position controller and a messenger is moved to the command position, a comparator **268** provides a signal to the elevator control **288** which, together with a signal from the messenger is position microswitch at the prescribed tank station, commences elevator operation to load or unload at the work station.

To prevent improper and possibly damaging operation of the conveyor system, a number of safety features are incorporated in the auxiliary control relays to insure safe operation of the messengers and elevators.

FIG. **12** is the relay portion which controls the messenger operation. A command to messenger "A" closes motor "A" relay contacts **292** for initiating operation of servo "A" amplifier **204**. However, to complete the circuit to the servoamplifier the elevator down position contacts **294** and the no load indication contacts **296** must be closed, or the elevator up contacts **298** and the load in position contacts **300** must be closed as indicated by the parallel network. That is to say, the messenger cannot be moved if the elevator is in the load/unload position or is moving between the up and down positions. Travel of the messenger is permitted only when the elevator is down and unloaded or up and loaded. Further, relay contacts **302** which are controlled by the proximity comparator **286** of FIG. **11** must be closed, brake contacts **304** which are controlled by the messenger brake must be closed, overtravel contacts **306** which are located on microswitches at either end of the rail assembly must be closed, and contacts **308** which are controlled by the messenger arriving at the command destination must be closed. Thus, for the messenger to operate in response to a command, the elevator must be down and unloaded or up and loaded, proximity comparator **286** must indicate a safe distance between messengers, and the messenger brake must not be actuated. Further, should the messenger travel exceed the limit of the rail assembly, overtravel switch **306** is opened thus stopping the messenger, and once the messenger arrives at the command position relay contacts **308** are opened thus deenergizing the messenger drive.

The relays for raising and lowering the elevator on messenger "A" are illustrated in FIG. **13**. Power to actuate the raise elevator "A" relay **310** includes the parallel network shown generally at **312**, and power to actuate the lower elevator "A" relay **314** includes a parallel network shown generally at **316**. Referring first to the raise elevator circuitry, an elevator overtravel relay **318** is normally closed but is opened upon the elevator overtravelling either the upper position or the lower position. Power to the raise relay **310** is provided through the overtravel switch **318** and through one of the three legs of parallel network **310**. The upper leg is for test mode operation and includes a manually operated relay **320** which is serially connected with test mode relay **322**. Automatic mode operation of the elevator is provided by the middle and lower legs of the parallel network **312**. The middle leg includes relay **324** which is closed when the workpiece supported by the tank agitator assembly is unclamped and thus ready to be raised. Serially connected with relay **324** is relay **326** which is closed when no lower command is present (thereby preventing conflicting command signals), lower position relay **328** is closed when the elevator is in the lower position, relay **330** is closed when the messenger is in position at the proper work station, and relay **332** is closed when automatic mode operation is desired.

Should the messenger be at the load station and a raise command is received, a load station relay **334** is provided which shunts the unclamped relay **324** since load stations do not have clamps. Once the elevator begins moving upward it will be noted that the center leg is opened by the lower position relay contact **328** opening. In order to continue the raising of the messenger to the upper position the bottom leg further includes a bar in place relay contacts **336** which normally is closed but opens should the elevator move past the intermediate pickup position and the load support means fail to actuate switch **74** (see FIG. **6**). Serially connected with contacts **336** are bypass relay **338** which is opened upon movement of the elevator and proximity switch **340** which is normally closed but opens upon receiving a warning from the proximity comparator **286**, shown in FIG. **11**.

In series with the parallel circuit **312** is a relay **342** which opens upon the elevator assuming the upper position and a safety interlock **344** which cooperatively functions with a safety interlock relay **346** in the lower command circuit to prevent relays **210** and **214** from being simultaneously energized.

The lower elevator command relay circuit including parallel circuit **316** is very similar to the above-described circuit for the raise command. The lower elevator relay **314** is energized through overtravel contacts **318**, through the parallel network **316**, through relay contacts **348** which opens upon the elevator assuming the lower position, and interlock relay contacts **346**. Again, the parallel network **316** includes three legs including an upper leg having a manually operated relay **350** which is serially connected with manual mode operation relay contacts **352**. The center leg includes relay contacts **354** which indicate that the clamp solenoid is deenergized, contacts **355** which indicate that no raise command has been received, relay contacts **356** which are closed with the elevator in the upper position, relay contacts **358** which are closed when the messenger is in the proper work position, and the automatic mode operation contacts **360**. Shunting contacts **354** are unload position contacts **361**. The bottom leg comprises bypass relay contacts **362** which are closed upon the lowering of elevator "A" and provides a bypass to the center leg which relay contacts **356** open. Serially connected with bypass relay contacts 362 are proximity comparator control relay contacts 364 which stop operation of the elevator upon receipt of a command from proximity comparator 286, shown in FIG. 11.

When the elevator assumes either the upper or lower positions, a time delay relay 370 momentarily closes thereby initiating a "send message" signal which is generated by the circuit shown in FIG. 14. The time delay relay 370 is energized through upper position relay contacts 372 or lower position relay contacts 374 which are closed upon the elevator assuming the upper position or lower position.

Referring to FIG. 14, the computer is advised that the previous command has been completed by means of the time delay relays actuated by the elevator assuming either the upper or lower position, indicated at 370, or a similar time delay relay 376 upon the messenger moving to a park position at either end of the messenger travel tracks. Thus, when either the elevators move to the upper or lower positions, or the messenger moves to a park position, time delay relays are momentarily closed thereby sending a next command signal back to the computer.

The relay controlling the clamp at each work station are illustrated in FIG. 15. As above described with reference to FIG. 13, the elevator motor is disabled when the clamp at the work station is activated and holding a work support means in position within the tank. Thus, in order to allow the elevator to function at a particular work station, the clamp solenoid relay 380 must be deenergized. Clamp 380 is energized whenever a workpiece is in place thereby closing relay contacts 382 and neither messenger "A" nor messenger "B" are at the work station as indicated by the position controller thereby opening relay contacts 384 or 386, or a process at the particular work station is in progress thereby closing relay contacts 388, or a messenger is not in position at the particular work station as indicated by the messenger sensing means at each work station thereby rendering relay contacts 390 closed. Thus, in order for a messenger to pick up a workpiece at the particular work station, the process at the work station must be completed, and a messenger must be at the selected tank location as indicated by the position controller and by the messenger sensing means at the work station.

An operation cycle for the messenger is as follows:

1. Receive command.
2. Move empty with elevator in lower position to the programmed tank position.
3. Raise elevator, engage work support rack and elevate to upper position.
4. Request next command.
5. Receive command.
6. Move loaded to programmed tank position.
7. Lower elevator, deposit work support rack in the tank.
8. Lower elevator to down position.
9. Request next command.

A specification summary of one embodiment of the conveyor system in accordance with the above description is as follows:

Number of Tanks—30
Distance Between Tank Centerlines—30±½ inches (nonaccumulative)
Park Stations—one/messenger; at opposite ends
Load/Unload Station—One Each at Same End
Messenger Weight—300 pounds maximum including work load
Messenger Support—Ball Bearing on 2-inch Diameter Rail
Drive—Direct Cable Drive
Horizontal Positioning Accuracy—±0.250 inch
Horizontal Transfer Acceleration/Deceleration—5.33 feet/sec.^{2} (constant)
Horizontal Transfer Velocity—10 feet/sec. maximum
Horizontal Drive Cable Size—⅛-inch Diameter (7×19) s.s.
Horizontal Drive Sheave—9-inch Diameter
Horizontal Drive Motor—Servo-controlled

Horizontal Messenger Travel—1,052 inches, Park A to Park B
Horizontal Messenger Braking—Dynamic plus Mechanical Braking
Horizontal Position Sensing—Incremental Encoder

While the invention has been described with reference to a specific embodiment and application, the description is illustrative and is not to be construed as limiting the scope of the invention. Various modifications and changes may occur to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. A conveyor system especially suited for computer controlled operation comprising:

a. a plurality of work stations,
b. work receiving means associated with each work station,
c. a horizontal rail means spaced from and aligned with said plurality of work stations,
d. at least one messenger means movable along said horizontal rail means for transporting work means between work stations,
e. said messenger means including elevator means for depositing or removing work means at said work stations and vertical rail means along which said elevator means travels,
f. drive means for said messenger means and for said elevator means, and
g. control means for selectively moving said messenger means to work stations and removing or depositing work means at said work stations including position register means and digital encoder means associated with said drive means for cooperatively indicating the position of said messenger means, and resync transducer means associated with said horizontal rail means for correcting errors in said position register means as said messenger means moves along said horizontal track.

2. A conveyor system as defined by claim 1 wherein said plurality of work stations are process tanks and said work means includes printed circuits and a work support means.

3. A conveyor system as defined by claim 1 wherein said work support means includes a vertical depending member which is supportably received by said elevator means.

4. A conveyor system as defined by claim 1 and including two messenger means movable along said horizontal rail means.

5. A conveyor system as defined by claim 4 wherein said control means includes comparator means for comparing indicated positions of said two messenger means and generating signal in response to said indicated positions approaching each other below a minimum limit, said drive means for said messenger means and for said elevator means being responsive to said signal and stopping movement of said messenger means and said elevator means.

6. A conveyor system as defined by claim 1 wherein said control means includes switch means associated with each work station for indicating the presence of a messenger and the completion of a process operation, switch means associated with each work receiving means for indicating the presence of a work support means, switch means associated with said elevator means for indicating an upper elevator position and a lower elevator position, and for indicating the presence of work support means in said elevator means.

7. A conveyor system as defined by claim 6 wherein said control means further includes means for permitting messenger movement along said horizontal rail means only where said elevator means is in said upper position and loaded or is in said lower position and unloaded.

8. A conveyor system as defined by claim 7 and including two messenger means movable along said horizontal rail means.