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(54) Flexographic or indirect rotogravure printing machine.

(57) The flexographic printing machine includes a central counterimpression drum (CC) for the support and movement of the material to be printed (NA) and two removable lateral printing units (U1, U2). Each unit is made up of color stations or color groups (G1,G2,G3; G4,G5,G6) located on a side of the central drum and by a system of rotating cylinders (CP1,CP2...CP6; CR1,CR2,...CR6) for transferring the ink and the subject to be printed onto the material (NA).

At each job changeover the two printing units, by means of a lateral backing onto guides (GL) and traverse orthogonal movement made by means of translation trolleys (CT) , are routed to a remote station where the color stations are worked on in receiving the maintenance, tooling and presetting operations, while other two substitute units, already made ready or tooled for the next printing cycle and preset to be coupled with the central counterimpression drum, are moved to their work position against, and at opposing traverse relation to, the central drum.

The presetting operations are conducted at the remote station by means of a simulation apparatus that includes some fixed shapeds that simulate both the central drum (CC) and the control means of the color station cylinders.

The machine productivity increases by 35-50% with respect to conventional machines due to the fact that at each job changeover, the preparation operations on the color stations for the next printing cycle do not take place on the machine itself, but in a remote station far therefrom, thus allowing the machine to remain working, and in this manner achieving a remarkable reduction in machine downtime.

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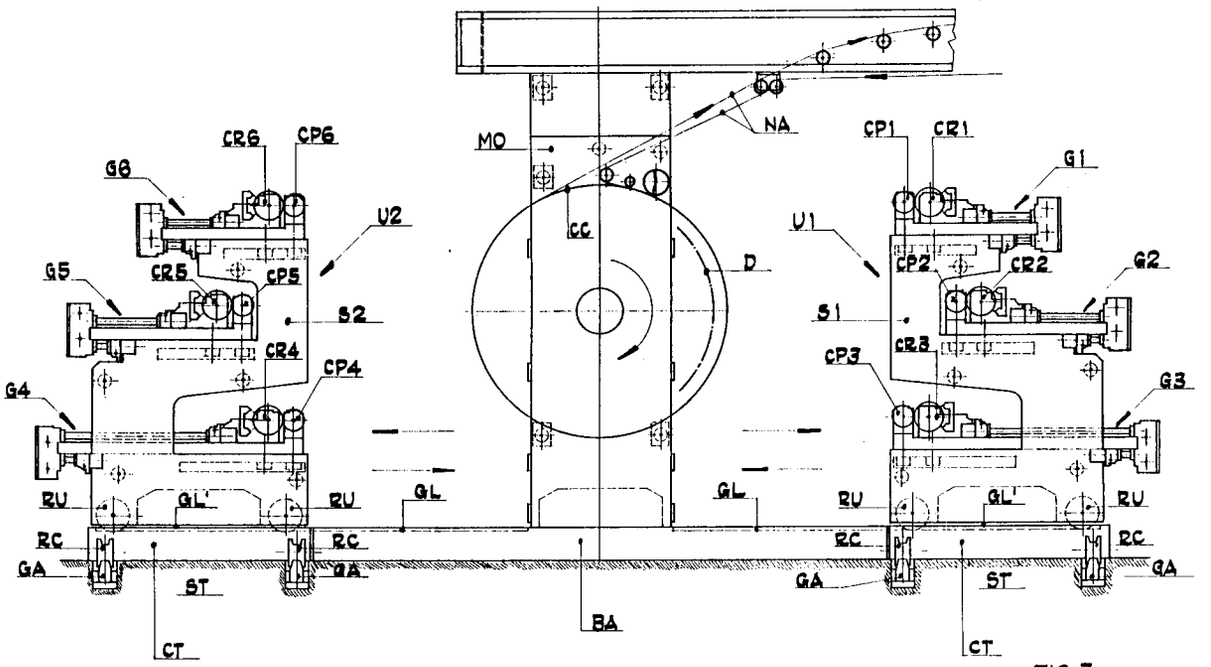
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CT

FIG.3

BACKGROUND OF THE INVENTION

The present invention refers to a flexographic or indirect rotogravure printing machine of the type that substantially includes:

- a central structure formed by a counterimpression rotating cylinder or by a plurality of independent counterimpression rotating cylinders acting as support and drive means for the material to be printed,
- a plurality of color stations or color groups distributed around the counterimpression cylinder or cylinders for the application of colors and including a system of rotating cylinders for transferring the ink and the subject onto the material to be printed, and
- control means for the counterimpression cylinder or cilynders and the system of rotating cylinders of color stations.

Printing machines of the above-mentioned type are known, and they are based on the ink transfer from its tray onto the material to be printed by means of pairs of rotating cylinders driven in rotation by drive gears associated with the counterimpression cylinder/s of the central structure.

In flexographic printing machines, a first cylinder or plate cylinder supports the printing form or plate that is made up of particular polymers and reproduces the subject to be printed in positive relief, while a second cylinder or screened (or Anilox) cylinder is accurately worked and acts on the surface of the first cylinder and is used for applying the amount of ink to be transferred to the printing plate on the plate cylinder.

In the indirect type of rotogravure printing machine, the structure of the two cylinders is different. Instead of a plate cylinder, a solid rubber-covered cylinder is used, and instead of the screened cylinder, a photoengraved copper cylinder is used that reproduces the subject to be printed in negative relief.

In either machine types, the feeding of the ink to each pair of rotating cylinders can be carried out by means of a third rotating cylinder. This third cylinder is also rubberized and is partially immersed into a tray holding the liquid ink. At the same time, it is in skimming or close contact with the screened (engraved) cylinder. Alternately, the feeding of the ink can be carried out by means of an ink tray of the closed chamber type, commonly referred to as a "chambered doctor blade". This last transfers the ink onto the screened cylinders by applying it with a skimming blade.

This feeding system allows a better and more accurate application of the ink onto the cylinders, thereby improving the printing quality. As it is known, the main drawback of the flexographic or indirect rotogravure printing machines is that productivity capability is not satisfactory. This is due to the fact that, at each job changeover, the maintenance, tooling, presetting and micrometric adjustment operations of the various color stations, necessary for preparing them for the next printing cycle, are made by the operator with the color stations directly on the machine, thus requiring the machine to be in a standstill or down condition, and hence non productive.

With reference to a flexographic printing machine having a central counterimpression drum and an ink feeding system of the doctor blade type, the above mentioned operations require, at each job changeover, the following main interventions:

A) Making-ready operation

- releasing the printing pressures by means of a small hydraulically controlled backing movement of the printing cylinders;
- opening safety guards (covers) for the print gears' protection on the two sides of the machine;
- releasing the safety lock stops of the color stations;
- complete (manually, pneumatically or electric motor controlled) backing of the color stations to the cylinders loading/unloading position;
- removing the ink feeding and unloading pipes from the "chambered doctor blade" and from the drain ink tray;
- removing the protections preventing the ink dispersion (splash guards);
- removing the "chambered doctor blades";
- opening the supports caps of printing cylinders;
- removing the printing cylinders;
- cleaning the parts fouled with deposits of dried ink, eventual lubrication of rotating members and eventual replacement of bearings or bushes of the rotating members;
- replacing the recovery ink trays;
- positioning new printing cylinders;
- closing support caps of printing cylinders;
- inserting drive gears onto the axle of each cylinder of the color stations;
- positioning doctor blades suitably prepared for the new job type;
- positioning protections against the ink dispersion (splash guards);
- connecting ink unloading/feeding pipes to the "chambered doctor blades" and recovery ink trays; and
- advancing the color stations to the presetting position.

B) Presetting

- meshing the gears of the printing cylinders with one another and with the main machine transmission;
- presetting the angular position of plate cylinders; this is done by making small rotations of these cylinders around their respective axles, until to reach an angular position which is near the final adjustment position, being that position which satisfies the printing register with the perfect overlapping of all the colors to be printed in succession;
- presetting the transversal position of plate cylinders; this involves an adjustment by means of small traverses of these cylinders along their respective axles until to reach an axial position which is near the final adjustment position; and
- closing the safety guards of the printing gears.

C) Final adjustment

- feeding ink to the "chambered doctor blade";
- starting-up the machine at low speed;
- applying printing pressures; this is done by having the "chambered doctor blade" made contact with the screened cylinder and the screened cylinder with the plate cylinder, and having the plate cylinder make contact with the material to be printed which is supported by the central drum;
- locking the color stations onto the machine in the work position;
- micrometric adjustment of the printing pressures by means of micrometric adjustment of the relative position of the various printing members with one another;
- micrometric adjustment of the angular position of plate cylinders; and
- micrometric adjustment of the transversal position of plate cylinders.

The above mentioned operations A), B) and C) must be repeated on the machine for each color station. Therefore, it can be understood that the machine' downtimes or inoperative times, are primarily due to the times incurred by the A) and B) operations, and this weighs heavily in limiting the machine's productivity. This is especially so where the machine includes many color stations and is subjected to frequent job changeovers during the work day.

As an example of the influence of these downtimes on productivity, consider the following three types of flexographic printing machines, each being equipped with 6 color stations:

1) Conventional machines with manual control.

This type of machines are exempt from particular automatisms and therefore the various operations of making-ready or tooling, presetting and micrometric adjustment as referenced above at paragraphi A), B) and C) are made manually by the machine operator.

Assuming the operator is very skilled, the minimum time required for the execution of the above mentioned operations is in the order of 100-105 minutes for each job changeover.

For 3 job changeovers in an 8-hour workday, the total downtime of the machine becomes on the order of 300-315 minutes. Use or productive time of the machine in 8 work hours is thus only 37,5%.

2) Partially motor-driven machine.

In this type machine, the backing and forward movements of supports for plate cylinders and screened cylinders are motor-driven and occur simultaneously in all of the color stations but the control is still visual.

Naturally, the amount of downtimes is less than that of a manually controlled machine but, nevertheless, the time required for esecution of the operations is still a minimun of 75 minutes for each job changeover.

For 3 job changeover in the 8 work hours, the total downtime of this type of machine is 225 minutes.

Use or productive time of the machine in 8 work hours is thus 53%.

3) Robot controlled machine.

In a robot controlled machine the backing and forward movement of cylinder supports for getting the final and exact positioning of plate cylinders and screened cylinders are driven by electric motors and controlled by a microprocessor.

Further, a robot is used for movement, such as in unloading the cylinders to be replaced and loading replacement or substitute cylinders.

Obviously, a notable reduction of the downtime is realized with use of a robot. Still, the operations require a minimum of 50 minutes for each job changeover or for 3 job changeovers in a work day of 8 hours, a machine stoptime of 150 minutes.

Use or productive time of the machine in 8 work hours is 68%. Despite the improved production time of robot controlled machines, it must be remembered that it is necessary to incur a great increase in plant costs for achieving this reduction of downtime from the use of robot controlled systems, and this increase is approximatively 100% compared to the cost of manual or partially motor-driven machines.

It is to be noted that the time valuations in-

dicated above are made with respect to complete job changeovers, such as the ones indicated by the sequences A), B) and C) . In some cases, these sequences can be simplified, as it is not always necessary to carry out each listed intervention at every job changeover. Therefore, the referred examples are indicative and serve only as parameters in the evaluating the benefits of the proposed invention.

SUMMARY OF THE INVENTION

A main object of the invention is to provide a new flexographic or indirect rotogravure printing machine that offers a drastic reduction in downtime associated with the tooling operation and the presetting the color stations at each job changeover, thereby greatly increasing machine productivity.

Another object is to supply a machine of the above-mentioned type in which the tooling and presetting operations can occur in a place more accessible and therefore more efficient and safe for the operator's work, resulting in a reduction of work accidents and improved maintenance on the machine.

According to the invention, the above-mentioned and other objects are realized in a flexographic or indirect rotogravure printing machine of the type specified above, characterized in that:

- two independent printing units are located respectively at the two sides of the central structure of the printing machine, each printing unit including color stations or color groups located at one side of the counterimpression cylinder or cylinders of the central structure and capable to being disengaged and moved away from the central structure for allowing, at each job changeover, its replacement with another unit already suitable for the next printing cycle;
- a station remote from the central structure (remote station) having one or more operative positions and suitable for receiving the printing unit to be replaced and for supplying a substitute unit already tooled or made ready for next printing cycle, and preset for its coupling with the central structure with the aid of a simulation apparatus including coupling means, operatively corresponding to the coupling means of the central structure with which the substitute unit is to be coupled, and finally;
- transport and control means for the movements of each printing unit from the central structure to the remote station and vice versa and for the movements of each printing unit (through) in the remote station.

In applying the above mentioned features, a machine structure is carried out that allows for the tooling and presetting operations of the printing units to be performed at a remote place far from the machine and therefore while the same machine continues to work, thereby increasing the productivity thereof by reducing the downtimes to only that necessary for the exchanging of the printing units between the central structure and the remote station at the time of each job changeover.

According to another feature of the invention, the simulation apparatus includes some shapes that simulate both the counterimpression cylinder or cylinders and the transmission means of the system of rotating cylinders belonging to the color stations.

Advantageously, the shapes of the simulation apparatus are located in a fixed position and, for each printing units are formed of a rigid cylindrical sector, or by a series of rigid cylindrical sectors, and also include a series of rigid toothed sectors simulating the gear/gears used for driving the rotating cylinders of the printing unit at color stations.

A simulation cylindrical sector or series of simulation cylindrical sectors are used considering whether the central structure includes a central cylinder or a plurality of independent counterimpression cylinders.

Preferably, the remote station is located in the same plane of the lower level of the central structure, in a position in front of, and in axial alignment with, the central structure. The remote station has three working positions: a central or intermediate position for unloading/loading the printing unit to be replaced and the substitute printing unit, and two lateral opposed positions for performing, respectively, the maintenance and/or tooling operation and the presetting operations on the substitute printing unit.

In this manner, the removal and replacement movements of the printing units can be developped advantageously following simple steps and with precision according to parallel and orthogonal translations.

Further characteristics and advantages of the machine according to the invention will be set forth in, or apparent from, the detailed description of the preferred embodiments of the invention which follow.

BRIEF DESCRIPTION OF THE INVENTION

For a complete understanding of the objectives and structure of the invention, reference is made to the following detailed description and accompanying drawings, wherein:

Figure 1 is a schematic front view of a type of flexographic printing machine according to the

invention, provided with six color stations and with printing units operationally connected to the central structure, in the machine's work or printing position;

Figure 2 is a plan view of the machine of Figure 1;

Figure 3 is a schematic front view of the flexographic printing machine of Figure 1, with the printing units withdrawn from the central structure;

Figure 4 is a schematic front view of the remote station associated with the machine, with the printing units operationally connected to the simulation apparatus for conducting the presetting operations;

Figure 5 is a plan view of the remote station of Figure 4;

Figure 6 is a another plan view of the remote station of Figure 4, but with the printing units withdrawn from the simulation apparatus;

Figure 7 shows the machine of Figure 1, but with a different ink feeding system;

Figure 8 shows the machine of Figure 1, but with a different central structure, specifically a central structure made of independent counterimpression cylinders, and with the same ink feeding system shown in Figure 7; and

Figure 9 is the schematic representation in plan view of a compound printing plant or apparatus, including two printing machines of the type having a central drum and associated with a single remote station.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Figures 1, 2, 3 and 7, the flexographic printing machine includes known features of a single central counterimpression cylinder or central drum CC and six color stations or color groups G1,G2,G3 and G4,G5,G6, located on the two sides of the drum for the application of single colors, according to the prefixed sequence, onto the material to be printed.

Drum CC serves the function of supporting and driving the material that is fed into the machine in the form of a band NA, and can be made by any material suitable for being printed; for example, it could be a polypropylene film for the packing of foodstuffs, such as pastry, deep-freezed foods, etc. , paper for the packing of animal feed, or cardboard for packing drinks, fruit suices, etc..

Band NA is supplied by an unwinding device for a roll of the unprinted material and, after its printing, it passes through a drying system for the drying of the ink dilution solvent. Finally, it is rewound onto a printed band bobbin or printed roll that represents the finished product of the machine. For clarity, the above mentioned systems are not represented in the drawings.

The central drum CC and its driving gear D (see Figure 2) and related driving transmission (not represented) form the fixed central structure SC of the machine that is mounted onto a support that includes lower support BA and two lateral uprights supports MO.

Each color station has two rotating cylinders indicated by CP1,CR1;CP2,CR2...CP6,CR6, for the transfer of the printing subject and ink onto band NA, and a feeding system for the liquid, described in the following paragraphs.

The cylinders CP1,CP2,...CP6 are plate cylinders, while the cylinders CR1,CR2,...CR6 are screened cylinders having a surface formed by a plurality of cells for receiving the ink and trasporting it, in a batched quantity, to the plate cylinders with which the screened cylinders are in rotating contact.

The ink feeding system for the cylinders operates by means of closed chamber doctor blades RA1,RA2,..RA6, each (chamber) being provided with sliding blade that makes contact with the related screened cylinder.

Rotation of the cylinder groups is obtained by the driving gear D of the central drum CC that meshes with the gears DC1..DC6 for driving the plate cylinders CP1..CP6, and on its turn gears DC1...DC6 are also rotatably coupled with the gears DR1...DR6 for driving the screened cylinders CR1...CR6 (Figure 2). In this manner, all of the pairs of cylinders of the color stations turn in synchronism with the main gear D driving drum CC.

The machine shown in Figures 7 and 8 has a different ink feeding system. Instead of the doctor blade, it is used a third either solid rubber or rubber-covered roller CG1,CG2...CG6, that is immersed partially in an ink tray where the ink is supplied to the preferably rubber-covered roller, and on its turn the third cylinder transfers the batched ink to the screened cylinder CR1,CR2...CR6 by contact and sliding.

The machine in Figure 8 is also different as regards the central structure. Instead of one central drum CC, a plurality of independent counterimpression cylinders C1,C2,...C6, in a number equal to the number of color stations, are used for the support and driving of band NA. In this manner, each plate cylinder CP1,CP2,...CP6 is driven in rotation by the related counterimpression cylinder C1,C2,...C6. It is evident that all of the rotations are also synchronized with one another in this arrangement.

Figures 1, 2, 7 and 8 show that the color stations G1,G2,...G6 are located near central drum CC (Figures 1, 2 and 7) or near the independent cylinders C1,C2,...C6 (Figures 7, 8), when the ma-

chine is in its work or printing position. Nevertheless, before starting the machine and at each job changeover, each color station must be prepared or arranged for the desidered printing cycle, that is, it must be subjected to the necessary tooling, presetting and micrometric adjustment operations as indicated in the preceding paragraphs A), B) and C).

As stated above, these operations have theretofore been conducted, with machines as known in the art, directly on the color stations on the printing machine, and therefore the entire machine must remain inoperative for the full time required for the operations.

To reduce the machine's downtimes to a minimum during these operations, the machine according to a first embodiment of the invention, includes two independent printing units U1 and U2 (Fig.3) located at the two sides of the central structure SC, each unit containing the individual stations on the entire side of the structure, that is, the unit U1 includes color stations G1,G2 and G3 and the unit U2 includes color stations G4,G5 and G6.

Printing units U1 and U2 are connected to the central structure SC while the machine is running (Figures 1, 2) but, at each job changeover, they are released and moved away from the central structure to allow for their replacement with another two units (substitute units) already prepared for the new printing cycle, as they have earlier been tooled or made ready and preset during a time in which the machine continued to operate.

According to another feature of the invention, the above-mentioned operations of tooling and presetting of the removed units are made in a place or location far from the machine, referred to as a remote station. The location is selected to satisfy conditions that provide for the best access, as well as meet praticality and safety concerns for the operator.

According to the invention, the remote station is located on the same horizontal plane of the lower support BA (Fig.1) of the central structure and is positioned in front of, and in alignment with, the same central structure. It includes three operative positions for each printing unit (Figures 4, 5 and 6): a central or intermediate position PC for the input (unloading) of the unit to be replaced (replacement unit) and for the delivery (loading) of the substitute unit, and two lateral opposite positions PA, PR, both being in alignment with central position PC for conducting the maintenance/tooling and presetting operations on the unit.

The last operation is carried out with the aid of a simulation apparatus AS that operatively simulates the parts of the central structure SC with which the units are to be coupled.

With reference to the two printing units U1, U2, this apparatus includes two fixed central shapes formed by mutually facing cylindrical sectors CC1 and CC2 that simulate the central drum CC of the machine to which the units are to be operatively connected. The apparatus also includes, along a side of each central shape, shapes formed by areas of three fixed tooth sectors, namely D1, D2, D3 for the cylindrical sector CC1 and D4, D5, D6 for the cylindrical sector CC2, each simulating the toothing of the driving gear D (Figs. 2 and 3) or other drive means for the plate cylinders CP1, CP2...CP6 of the color stations G1,G2,...G6 (Figures 4 and 5). These shapes of cylindrical sectors CC1, CC2 and toothed sectors D1...D6 are mounted onto a support BA', MO' similar to the support BA, MO of the central structure SC.

The above-mentioned shapes are complimentary to operatively connect with the central drum CC and to the toothing of gear D of the central structure. Naturally the simplified design of these shapes at the remote station satisfies the simplicity and cost requirements of the plant with respect to another integral part of the system that involves duplicating the drum CC and the other parts associated with the central structure.

The movements that the printing units must make for reaching the remote station SR and then being located in the three positions PC, PA and PR of that station, and finally for returning to a printing position near the central structure, are controlled by control and guide means that operate the traverses of the units. The paths and movements thereover depend only on the practical exigencies of the plant.

In relation to the selection of the remote station position as above-described, it is advantageous, for simplicity and movement considerations, that the above-mentioned movements and control and guide means of printing units are made as described with reference to the description of the machine in its operating condition.

At the end of each printing cycle (Figures 1,2,7 and 8), the operator removes the various connections, releases the units from the central structure and controls their lateral traverses until the units are at their withdrawn positions designated as waiting position or station ST (Figure 3).

This traverse occurs under the action of a properly geared motor unit (not represented) that acts, by means of a suitable transmission, with the rollers RU mounted on the base of each support S1, S2 of the respective printing units, each support sliding onto fixed lateral guides GL, located in the same horizontal plane of lower support BA of the central structure.

When the units are at their waiting position ST, they are each located over a related transport trolley CT that is provided, on the upper part, of

fixed lateral guides GL', in alignment with guides GL.

Each trolley is provided, in the lower part with rollers RC sliding along fixed axial guides GA, perpendicular to the lateral guides GL, located between said waiting position ST, and the central position PC of the remote station SR, and in this manner the trolley transports the unit.

The translation of the trolleys CT to and from the position PC is driven by a belt or gear transmission by other drive means, not shown in the drawings.

As soon as each unit has reached position PC, the related geared motor in again driven causing the unit to be moved to the external lateral position PA, where it is submitted to the maintenance and tooling operations.

This traverse occurs by means of the sliding of unit rollers RU onto lateral guides GL' of the trolley and, as described further below, onto the aligned lateral guides GLA of the remote station SR that obviously are parallel to the lateral guides GL of the central structure.

While the removed units are being attended to with the maintenance and tooling operations in the remote station's external lateral position PA in preparation for the next printing cycle, two other substitute units, already tooled and preset for the next printing cycle, are moved from the other internal lateral presetting position PR of the remote station SC, where they were moved previously, into the intermediate position PC, where the trolley CT remained stopped after the unloading of the removed unit.

Similarly, this traverse of each unit into the central position PC occurs under the action of the geared motor of the unit acting on unit rollers RU sliding along fixed lateral guides GLR, in alignment with the guides GL' of the trolley CT, and naturally with aligned lateral guides GLA.

When the substitute units are positioned onto the related trolley, they are transported to waiting position ST and therefrom to the work position near the machine central structure SC. Obviously, the axial traverse of trolleys with the units made from the central position PC to the related waiting position ST occurs again under the action of its drive transmission. Similarly, the lateral translation of the units on the guides GL for movements to the central structure occurs again by the use of the geared motors unit associated with guides GL. At end of the replacement operation when the substitute units are positioned against central drum CC, only the operations of micrometric adjustments indicated precedently at point C) remain to be done. The maintenance and part replacement tooling or making-ready operations, and the rotating members coupling and printing register (presetting) operations that must be made at a job changeover, have already been carried out in the positions PA and PR, respectively, of the remote station SR (Fig.5). Naturally as soon as the micrometric adjustments are completed, the machine is started again for the execution of the next printing cycle.

In the meantime, each trolley CT has been moved from the waiting position ST to the central position PC of remote station SR for allowing passage of the already tooled or made-ready unit from the external lateral position PA to the internal lateral position PR, and then being brought again from the position PC to the waiting or parking position ST, awaiting the repetition of the above-mentioned steps at the next job changeover.

The traverses of the two units U1 and U2 to and from the central structure SC and into the remote station SR occur simultaneously; nevertheless it is obvious that these operations can occur at different times according to the pratical printing exigencies.

The activation of unit geared motors and control means of the trolley can be completely or partially automated.

From what is said above, the advantages of the machine according to the invention are clear. The machine's downtime at each job changeover is pratically reduced to the times required for the traverses of the units from the central structure SC to the remote station SR and vice versa, since the tooling and presetting operations of the substitute unit, operations that require longer times, occur at the remote station SR while the machine is still running and remaining productive.

Using the described machine of the invention, the replacement time of printing units is on the order of 5-6 minutes.

In a work day of 3 work cycles, the total downtime of a machine with 6 color stations thus does not exceed 15-18 minutes.

Consequently, the use time or production time of the machine according to the invention reaches and exceeds 96.30%.

It is clear that this advantageous result more than compesantes for the cost of the machine which requires, with respect to a conventional machine, a number of components.

The cost is also greatly compensated for by further advantages of the machine, notably the following:

- easy access and praticability of the machine with the result of better maintenance and therefore a longer duration of the machine;
- the number of required personnel remains unchanged with respect to a traditional machine;
- an improved printing quality is achieved due to the better maintenance and cleaning possi-

ble with the inventive machine;

- a longer production life of the whole machine since the main wear members are installed on the lateral mobile printing units; the machine life is practically doubled with respect to the life of a traditional machine;
- a reduction in size of economic fabrication plant outlay, which result in a capability to accept orders of smaller sizes at advantageous, i.e., profitable conditions; this satisfies the marketing efforts to expand to meet the need of overage, smaller customers;
- reduction of downtimes in circumstances involving major maintenance in the case where a major fault occurs in a part of the lateral mobile printing units; with the described machine, it is now possible to wait for the head office of the manufacturer to ship the damaged part, while using at the same time a substitute unit which, while perhaps causing a slight reduction of productivity, avoids the entire stopping of production as would occur with use of a traditional machine; and
- possibly during the construction of the machine, to use the mass production assembly lines with great production advantages. Figure 9 shows an alternative embodiment where a printing plant contains two printing machines operatively associated with a single remote station SR.

The first machine includes a central structure SC1 and the two lateral units U1 and U2, and the second machine includes a central structure SC2 and two lateral units U3 and U4.

Remote station SR is located centrally between the two structures SC1 and SC2 and with the simulation apparatus AS being aligned with the axles of the central drums CC of said structures.

The printing units U1, U2, U3 and U4 are substantially identical with one another except the plate cylinders CP1..CP6 and CP1'...CP6', on which the plates corresponding to the subjects to be printed are applied.

Therefore, the components of the two machines are again marked with the same reference symbols of the machine shown in Figures 1 and 6. The printing units U1,U2 and U3,U4 are shown operationally connected with the related central structures SC1 and SC2, while the two substitute units US are shown on the trolleys CT in the central position PC of remote station SR.

Considering the position as described of the various components, it is clear that the following handling shall concern the traverse of the units US from the above-mentioned central position CP to the presetting position PR.

The plant runs again as described for the single machine running, as shown in Figures 1 to 6, with one difference being that the movements of the units cannot all occur simultaneously in both machines.

Further, it is clear that it can be made a reciprocal exchange between the lateral units of the plant, as an unit remowed from a machine e.g. unit U1, can be tooled or made ready and preset for being a replacement for a unit of the other machine, e.g. unit U4 and vice versa.

The advantages of this compound printing plant or apparatus are that it gives the possibility of using a reduced numer of components as compared to the number of components necessary if the two machines were separate.

In particular, six printing units are used, four used sinmultaneously by being positioned adiacent to the two central drums (e.g. units U1,U2,U3 and U4) while two other units (e.g. US) are in the tooling or presetting operations. Thus, only six units are needed instead of eight units that would otherwise be required in the case of two separate machines. Also only two translation or transport trolley CT and a sole simulation apparatus AS are required instead of the four trolleys and two simulation devices supposed as is required in the case of two separate machines. Furthermore, the control electronics are practically one half of that normally needed and the installation space is greatly reduced.

Naturally, the operation must use a suitable production program in order to assure that the job changeover times of the two machines are not coincident.

The invention has been described in this two preferred embodiments. Obviously variants and modifications can be applied to the described embodiments without departing from the scope and spirit of the invention. Thus for example, the remote station can be of the rotating or oscillating platform type, provided that in either case, the station is suitable for placing the units in the positions necessary for carrying out the maintenance and/or tooling operation and presetting operations on the units.

Each remote station can be made of a simple type, that is, it can include a single shape with a cylindrical sector and a single area of toothed sectors. In this case, this station is located with its own simulation shapes in a position suitable for being used with the corresponding printing unit. In this manner, the two simple or unitary remote stations can be located, compatible with the available space, nearer to the two sides of the central structure in the positions previously identified as waiting positions or parking stations of the units for the translation trolley CT and indicated by ST. In this case, the trolleys and related control means and guides GA can be eliminated. Further, the control

means of the units and trolleys can be different from the means described above.

By selecting the steps properly, the geared motors can be made to drive to units also during the axial movements and similarly the translation trolleys can transport the units during the lateral movements, both in conjuction with the central structure and the remote station. Further, magnetic paths can be used at least in place of the guide rails of the trolleys.

A very technocally advanced form of the plant foresees that the traverses of the unit from one position to another position can be made by means of robots and, in that case, the double remote stations or the single remote station can be located in positions that are not necessarily in the same plane as lower support BA of the machine.

Finally, a simplified variant of the machine uses a push handling of the units and trolleys, with the advantage of a plant cost reduction, but with the disadvantage of increasing the job changeover times.

A more advanced variant incorporates a machine type with the handling of units and trolleys obtained by means of a computer-aided system that is activated by consent signals from sensors activated by traverses, for control of the movement of trolleys and units according to prefixed sequences.

Claims

1. A flexographic or indirect rotogravure printing machine of the type comprising substantially:
- a central structure (SC) mounted on a support and formed by either a counterimpression rotating cylinder (CC) or by a plurality of independent counterimpression rotating cylinders (C1, C2,...C6) for providing support and drive means for a material to be printed (NA),
- a plurality of color stations or color groups (G1, G2,...G6) distributed around the counterimpression cylinder or cylinders of the central structure, each color station usable for the application of a color and comprising a system of rotating cylinders (CP1, CR1,. ..CP6, CR6) for transferring of ink and a subject onto the material to be printed, and
- control means for the counterimpression cylinder or cylinders and the system of rotating cylinders of the color stations, characterized by the fact the printing machine further comprises:
- two independent printing units (U1, U2) located respectively at two opposing sides of the counterimpression cylinder or cylinders of the central structure, each printing unit containing color stations located on one respective side of said two opposing sides of the central structure (SC) and comprising means for being disengaged and moved away from said central structure for allowing, at each job changeover, its replacement with a substitute unit already suitable for the next printing cycle;
- a station (SR) remote from the central structure (remote station), having at least operative position suitable for receiving a replaced unit and for supplying to the central structure a substitute unit already tooled or made-ready for the next printing cycle, and preset for its coupling with the central structure with the aid of a simulation apparatus (AS); said simulation apparatus including coupling means operatively corresponding to the coupling means of the central structure with which the substitute unit is to be coupled, and
- transport and control means for the movements of each printing unit between said central structure (SC) and said remote station (SR) and for the movements of each printing unit in (through) said remote station.

2. A printing machine according to claim 1, characterized in that said coupling means of the simulation apparatus (AS) include shapes that simulate both the counterimpression cylinder or cylinders and the control means for driving the rotating cylinders system of said color stations.

3. A printing machine according to claim 2, characterized in that the shapes of said simulation apparatus of each printing unit are formed as a fixed cylindrical sector (CC1, CC2) or a plurality of fixed cylindrical sectors as well as are formed as a plurality of fixed toothed sectors (D1, D2...D6).

4. A printing machine according to claim 1, characterized in that the remote station (SR) includes different positions for the unloading/loading of the unit being replaced and the substitute unit, for the maintenance and/or tooling or making-ready operations of the unit being replaced, and for the presetting operations of the substitute unit.

5. A printing machine according to claim 1, characterized in that the remote station includes three operative positions comprinsing a central

or intermediate position (PC) for unloading/loading printing units and two lateral positions (PA, PR) aligned with and opposite to one another for the maintenance and/or tooling of a unit being replaced and for the presetting operations of a substitute unit, respectively.

6. A printing machine according to claim 1, characterized in that the movements of the printing units (U1, U2) from and towards the central structure (SC) and in (through) the remote station (SR) occur on the same horizontal plane as the lower supports (BA,BA') of the central structure and the remote station respectively and follow rectilinear and independent translation paths.

7. A printing machine according to claim 1, characterized in that the remote station (SR) is positioned in the front of and aligned with the counterimpression cylinder/cylinders of the central structure.

8. A printing machine according to claim 6, characterized in that the movements of each printing unit to be replaced, starting from the printing position against a side of the central structure (Figure 1, 2, 7 and 8), include:

a) a translation or lateral first move of the replaced unit as a withdrawal from the central structure, and a second axial move perpendicular to said first move ending at the intermediate (or unloading) position (PC) of the remote station (SR);

b) translation of the replaced unit from said intermediate position (PC) to the lateral position (PA) for maintenance and/or tooling operation of said remote station;

c) translation of a substitute unit, already preset in the presetting position (PR) after being moved from the tooling position (PA), to the intermediate (car loading) position of said remote station;

d) translation of the substitute unit from said intermediate position (PC) to the printing position against the central structure by means of reverse moves of that recited in paragraph a) above;

e) translation of the replaced unit after being tooled from the lateral tooling position (PA) of the remote station to the presetting position (PR);

the above-mentioned lateral translations of the units into the remote station being parallel with the lateral withdrawing or approaching moves of the units with respect to the central structure.

9. A printing machine according to claim 1, characterizd in that the control means for control of the movements of each printing unit to and from the central structure and in (through) the remote station include drive means acting on the same unit.

10. A printing machine according to claim 9, characterized in that at least the lateral moves of the units to and from the central structure (SC) and the lateral moves of the units between the lateral positions of the remote station (SR) are driven by a geared motor mounted in each unit and act on rollers (RU) of the same unit, sliding onto fixed horizontal guides or fixed paths (GL, GLA, GLR) , located at the two sides of the central structure and at two sides of the intermediate position (PC) of the remote station rispectively.

11. A printing machine according to claim 10, characterized in that at least the axial moves of each unit are made by means of a translation trolley (CT) suitable for sliding onto fixed guides or paths (GA), perpendicular to the lateral guides (GL) of the central structure, and located between a lateral position (ST) of the unit at the more withdrawn end with respect to the central structure or waiting station of the trolley and another position coinciding with the intermediate position (PC) of the remote station, and in that the translation trolley is provided, on its turn, with guides or paths (GL') in alignment both with the central structure lateral guides or paths (GL) when said trolley is located in its waiting station (ST) for receiving the replaced unit or delivering the substitute unit from and to said central structure respectively, and in alignment with the lateral guides or paths (GLA, GLR) of the remote station when said translation trolley is located at the intermediate position (PC) of said station so that the lateral traverses of the unit always occur through the trolley in said remote station and that, finally, during the time during which unit movements do not occur, the trolley is preferably stopped at the waiting position or parking station (ST) until a new printing cycle is initiated.

12. A printing machine according to claim 11, characterized in that at least the guides or paths of the translation trolleys (CT) are magnetic paths.

13. A compound printing apparatus including two component printing machines according to preceding claims, characterized in that the two

component machines are installed at two opposite sides and in axial alignment with a central remote station, so that said station can allow, at different times, the tooling or making-ready and presetting operations of the printing units of the two component printing machines.

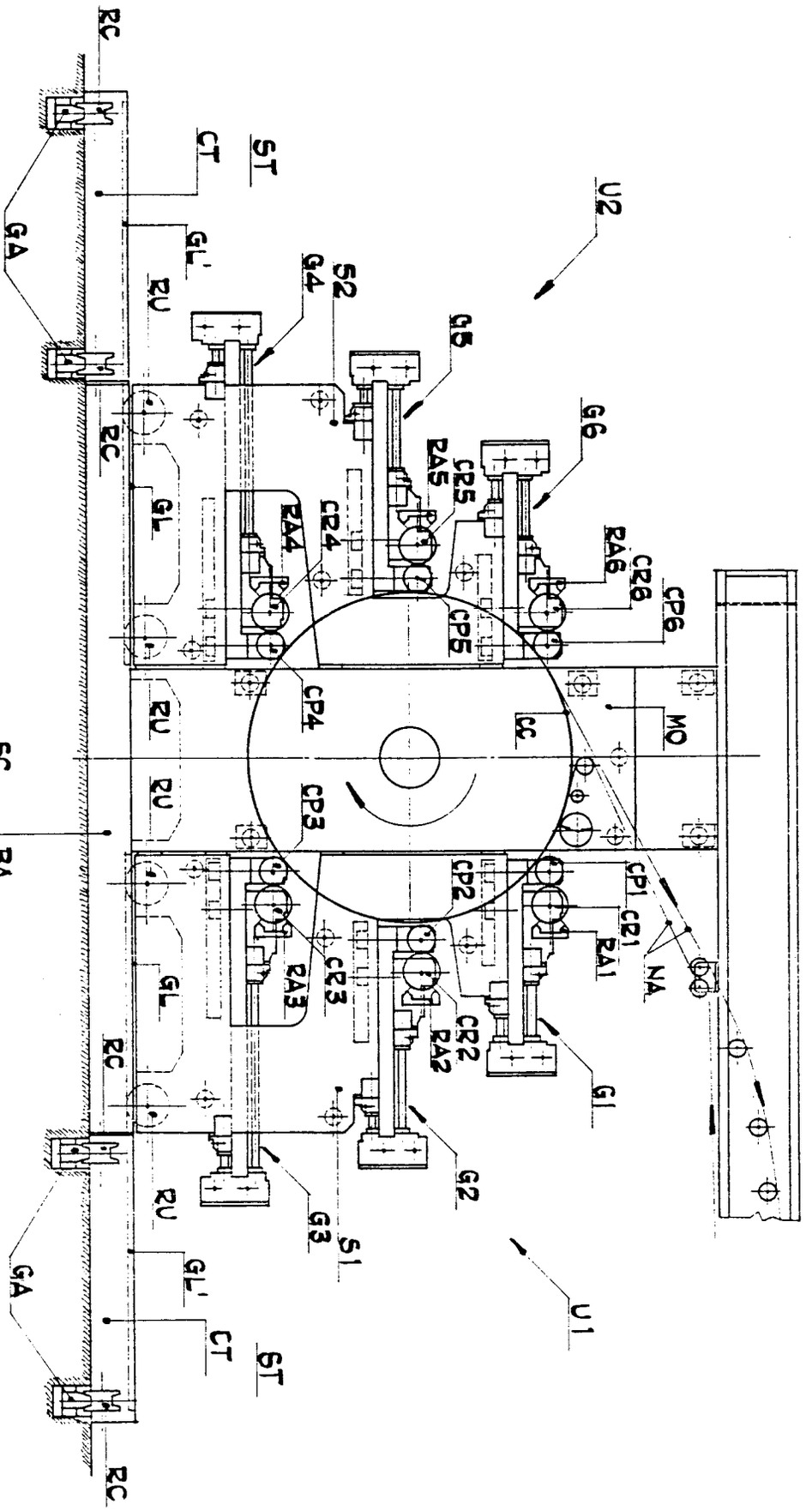
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FIG. 1

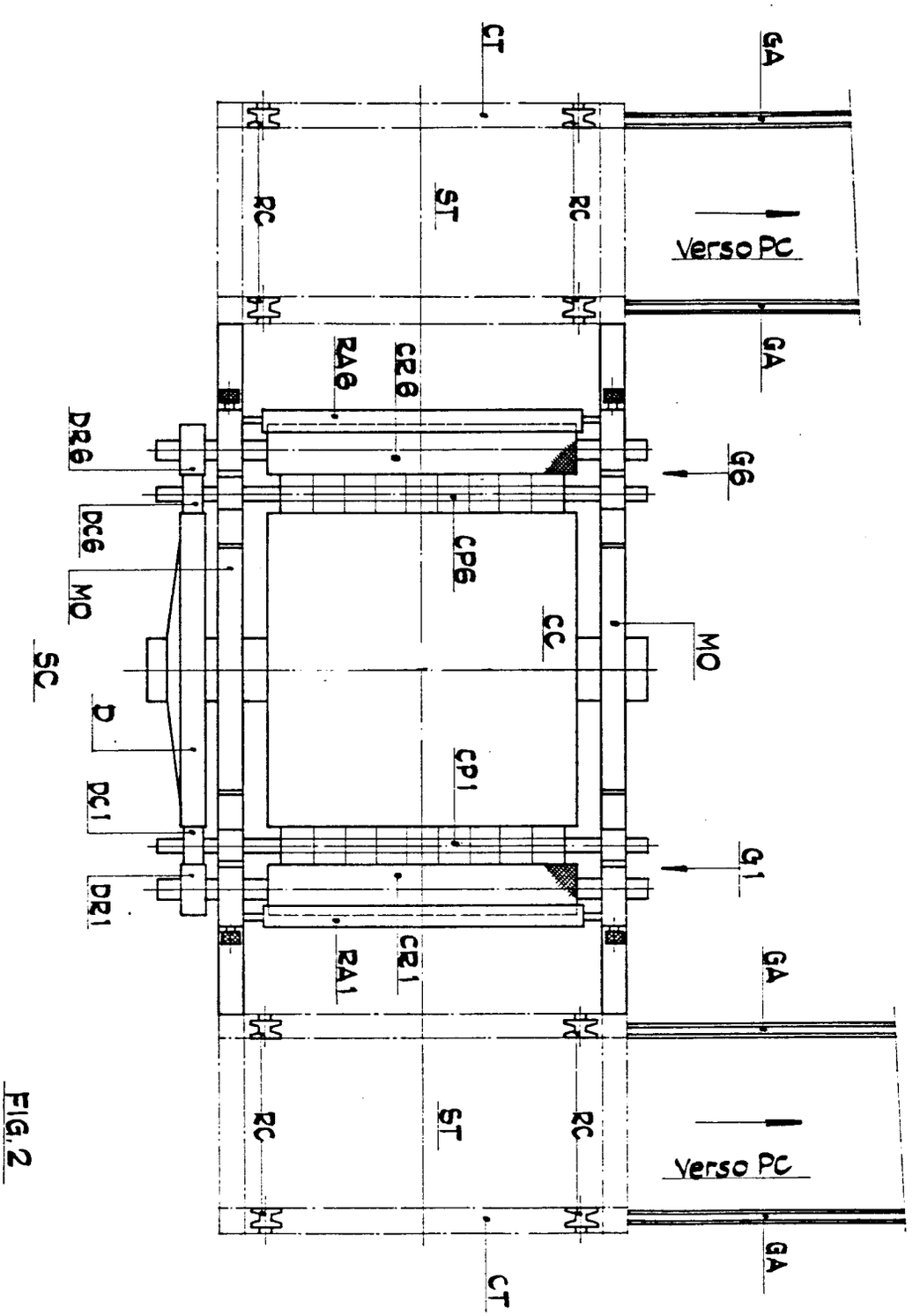
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FIG. 2

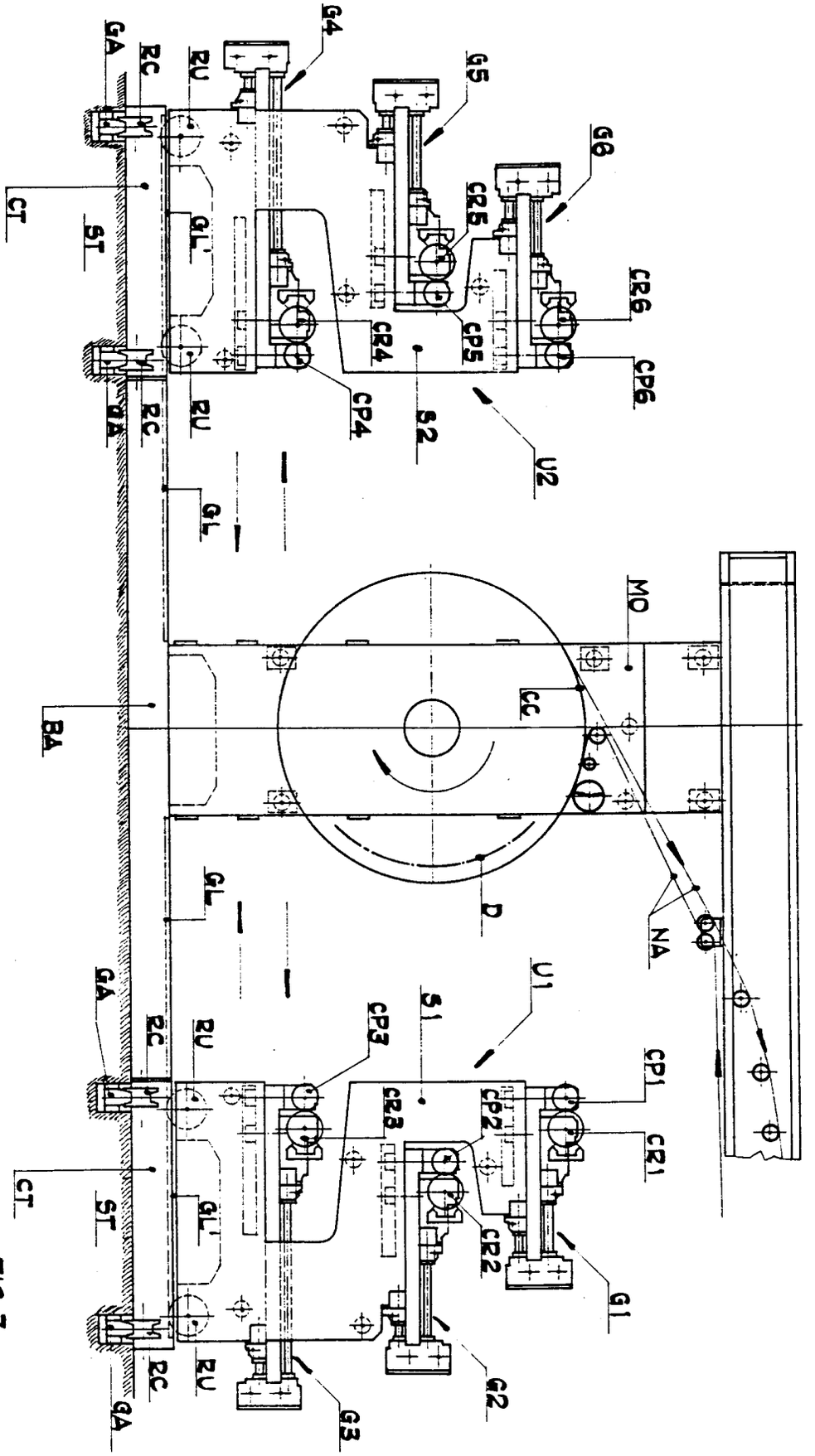
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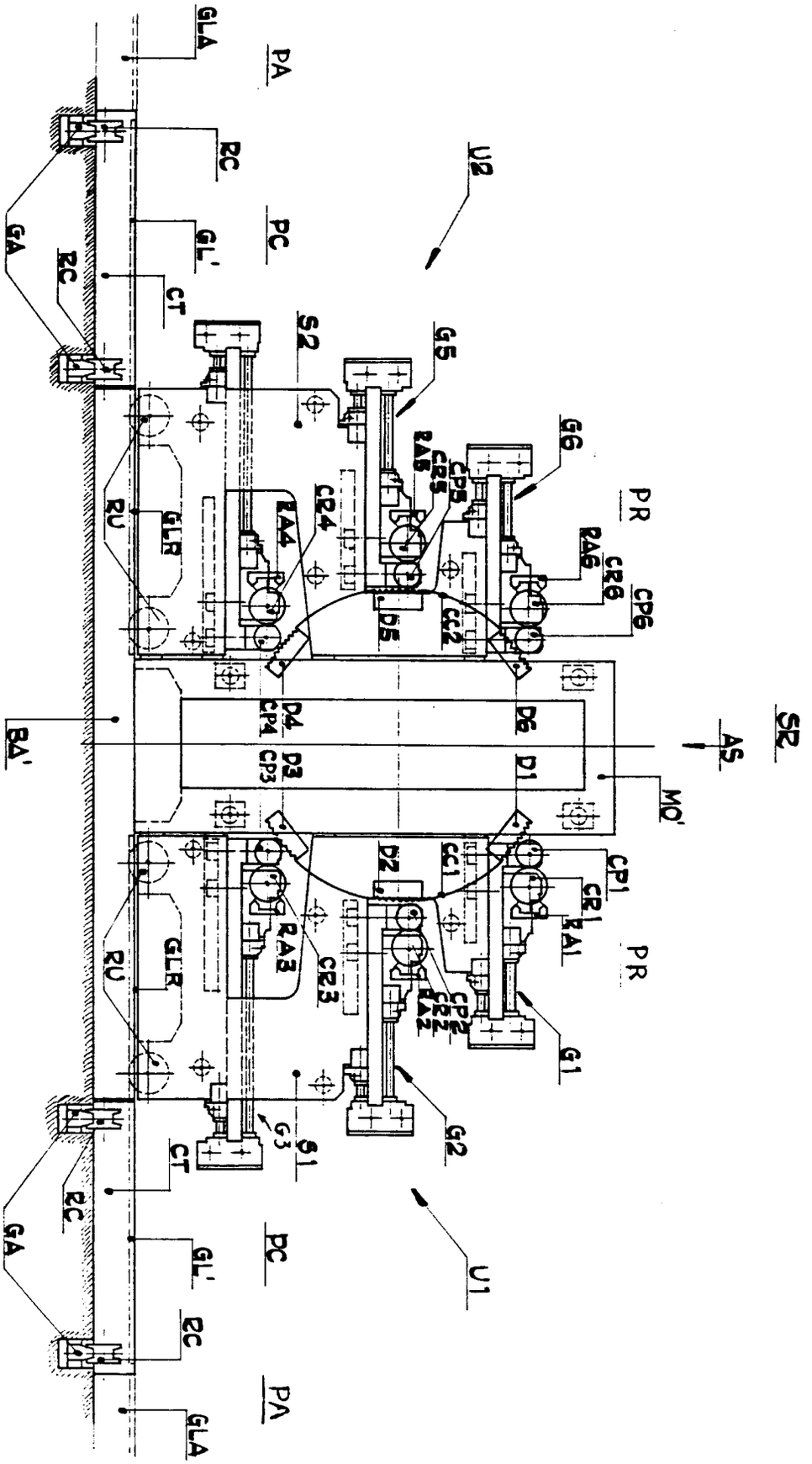
FIG.3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CC2
D4
CP4
D6
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D1
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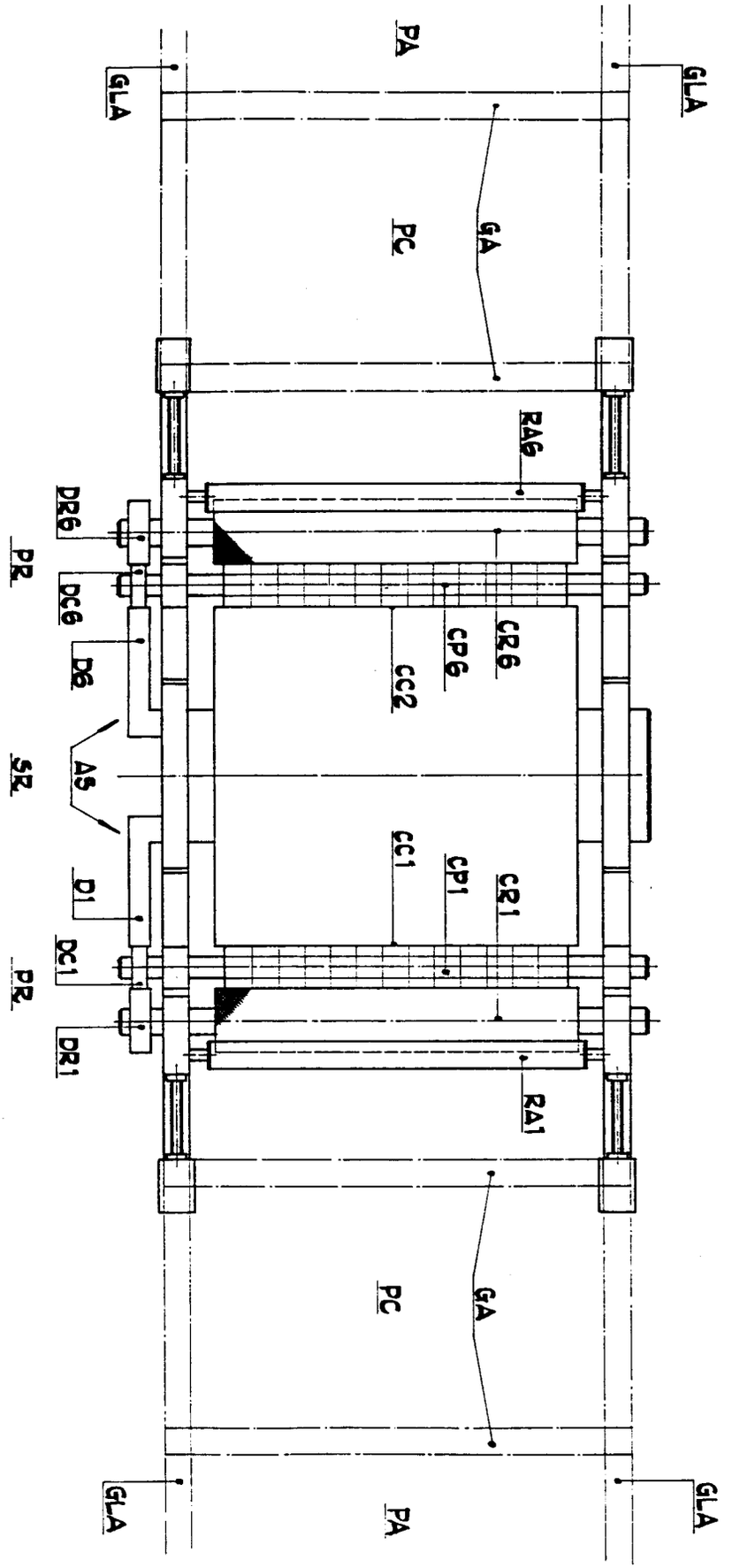
FIG.4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GLA

FIG. 5

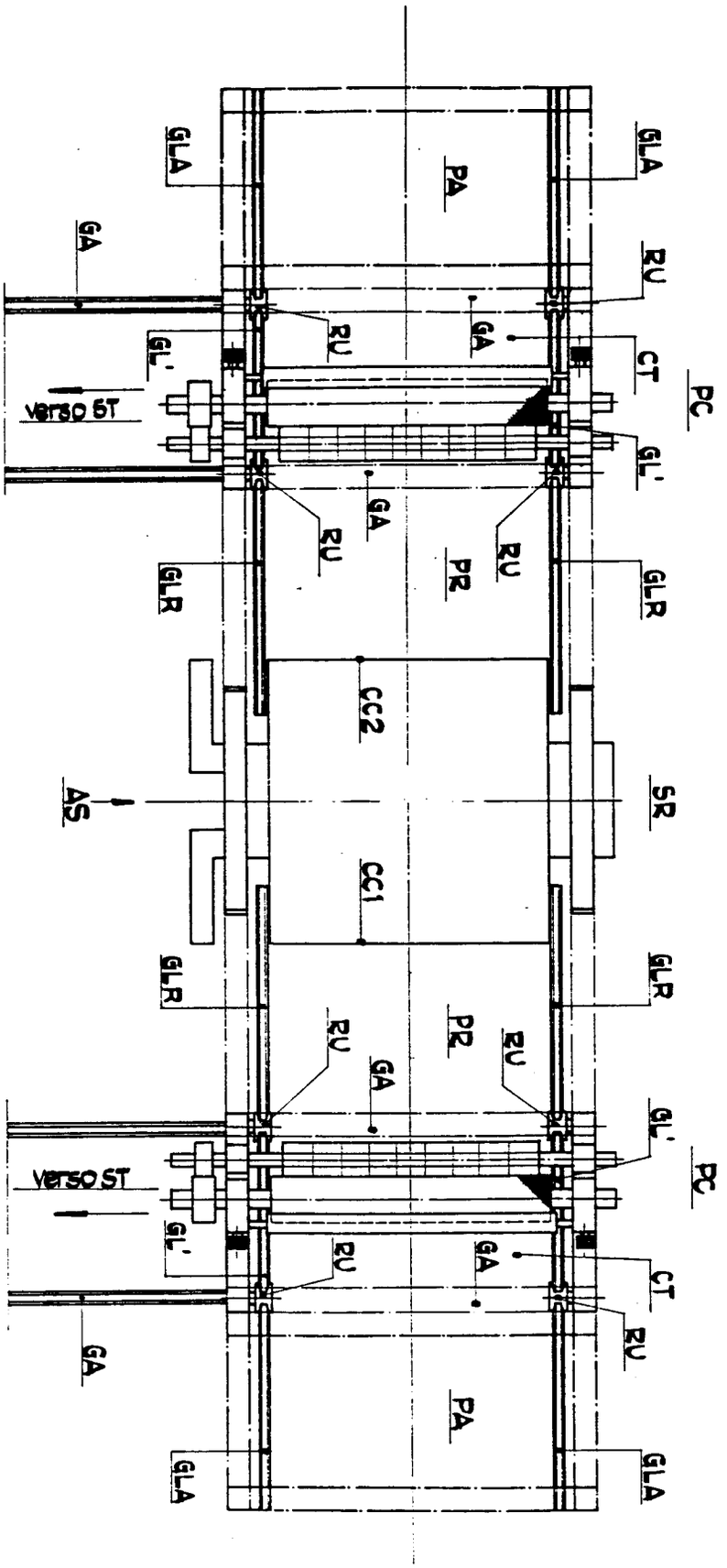
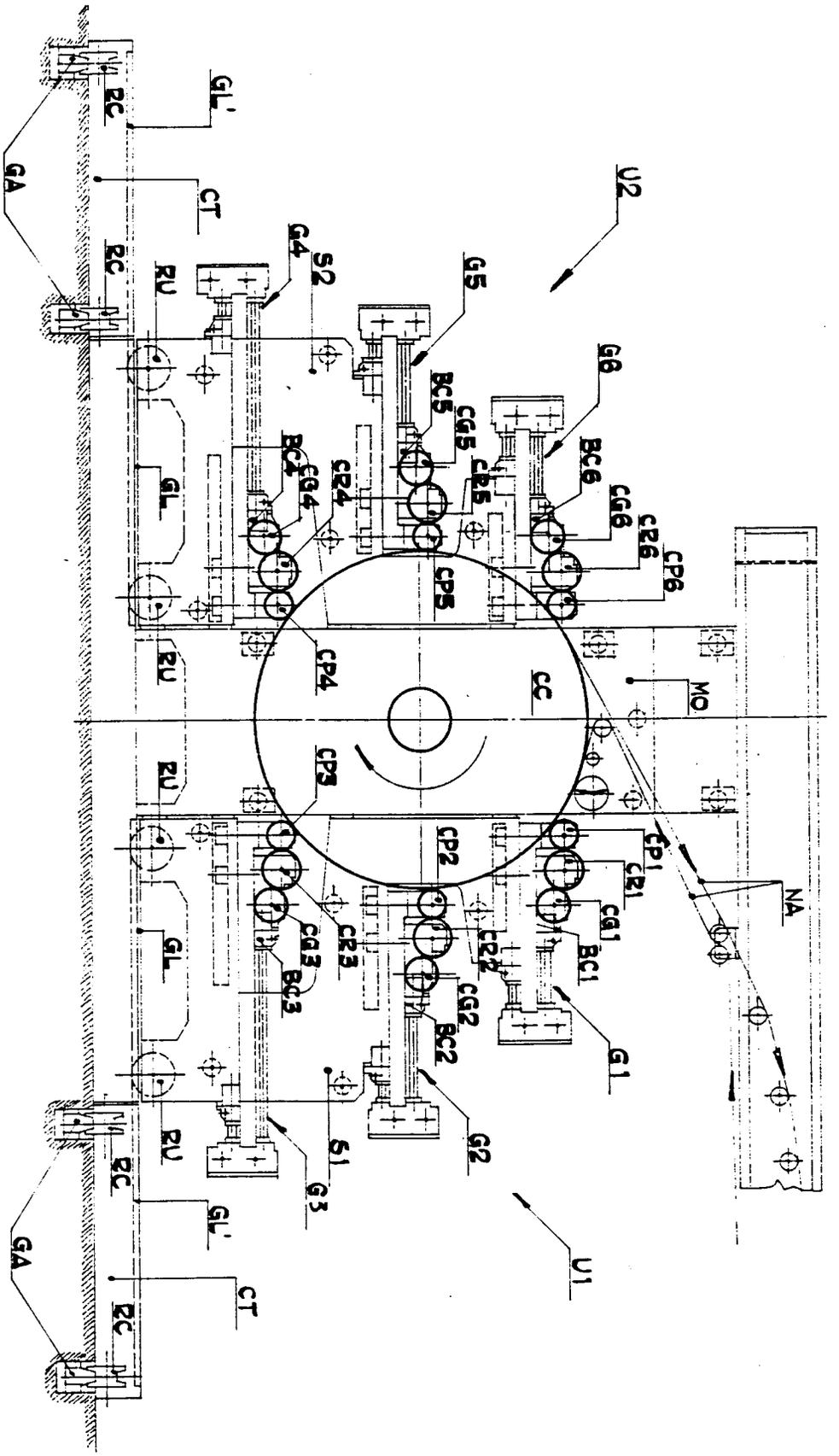


FIG. 6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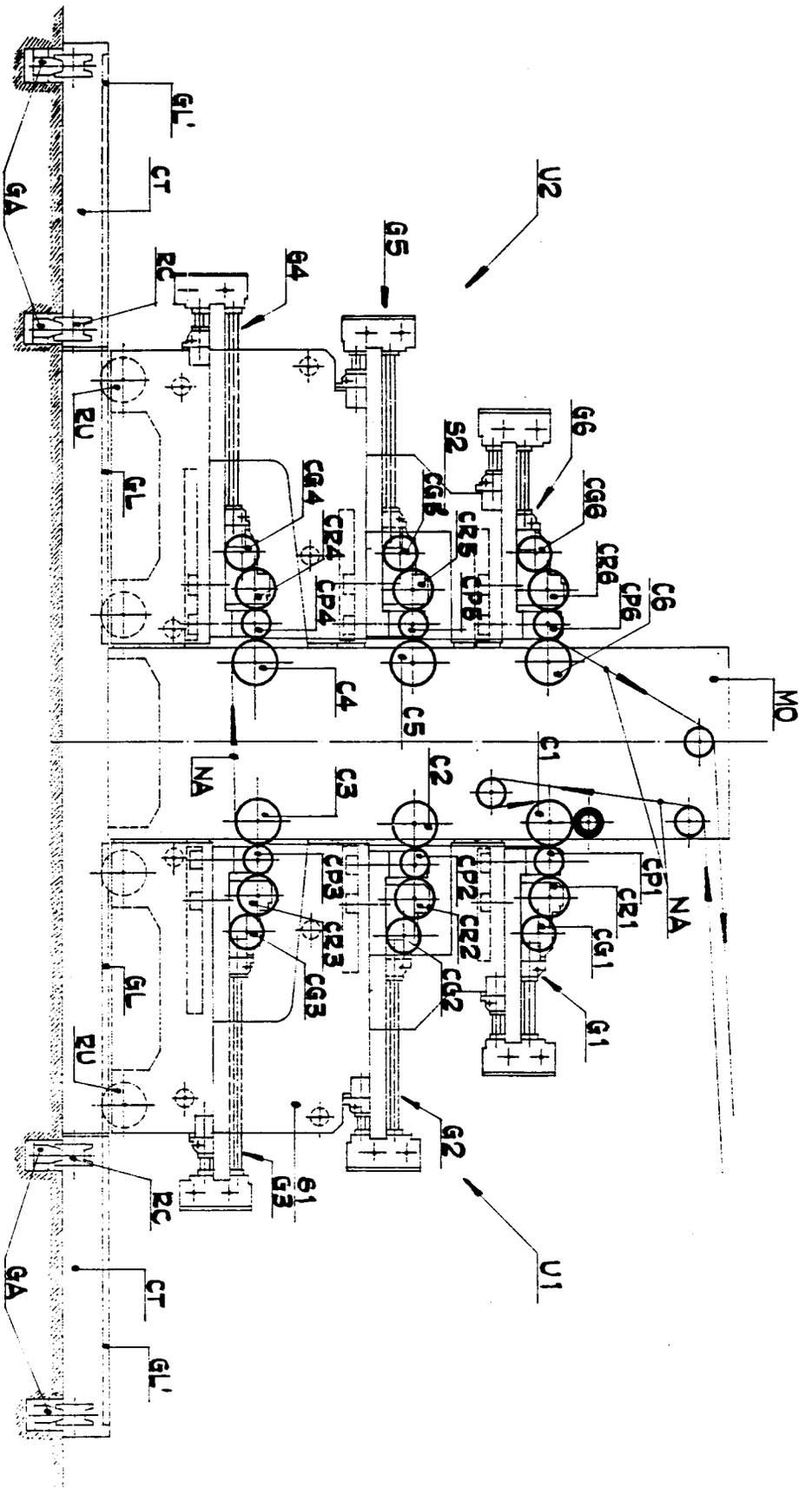
GA
CT
RC

FIG. 7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CR6
CP4
CP5
CP6
C6
C4
C5
MQ
NA
C3
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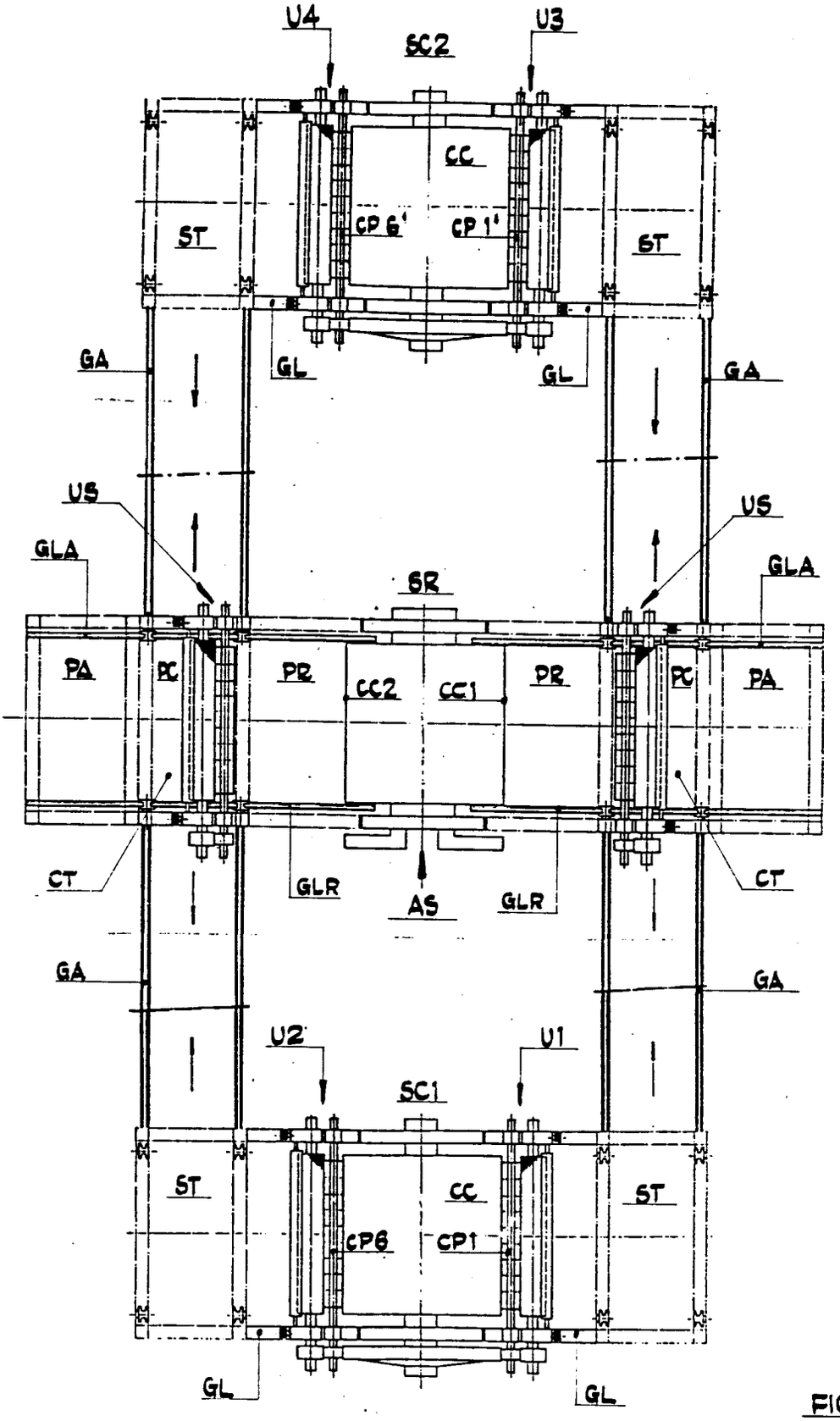
G2
G3
U1

FIG.8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PR
PC
PA
CT
CT
GLR
AS
GLR
GA
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U2
U1
SC1
ST
CC
ST
CP6
CP1
GL
GL

FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 11 5426

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A-1 003 887 (VEREINIGTE FARBEREIEN AKTIEN-GESELLSCHAFT) * page 2, line 119 - page 4, line 59; figures 1-4 * *	1-3,6	B 41 F 5/24 B 41 F 9/01
A	FR-A-2 420 426 (MACHINES CHAMBON)	1	
A	EP-A-0 186 862 (MAILÄNDER) * page 8, line 36 - page 15, line 15; figures 1-6 * *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 41 F

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	10 December 91	LONCKE J.W.

CATEGORY OF CITED DOCUMENTS

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