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CURRENT LEAD-IN DEVICES FOR CONTAINERS EMPLOYED IN ELECTROLYTIC TREATMENTS

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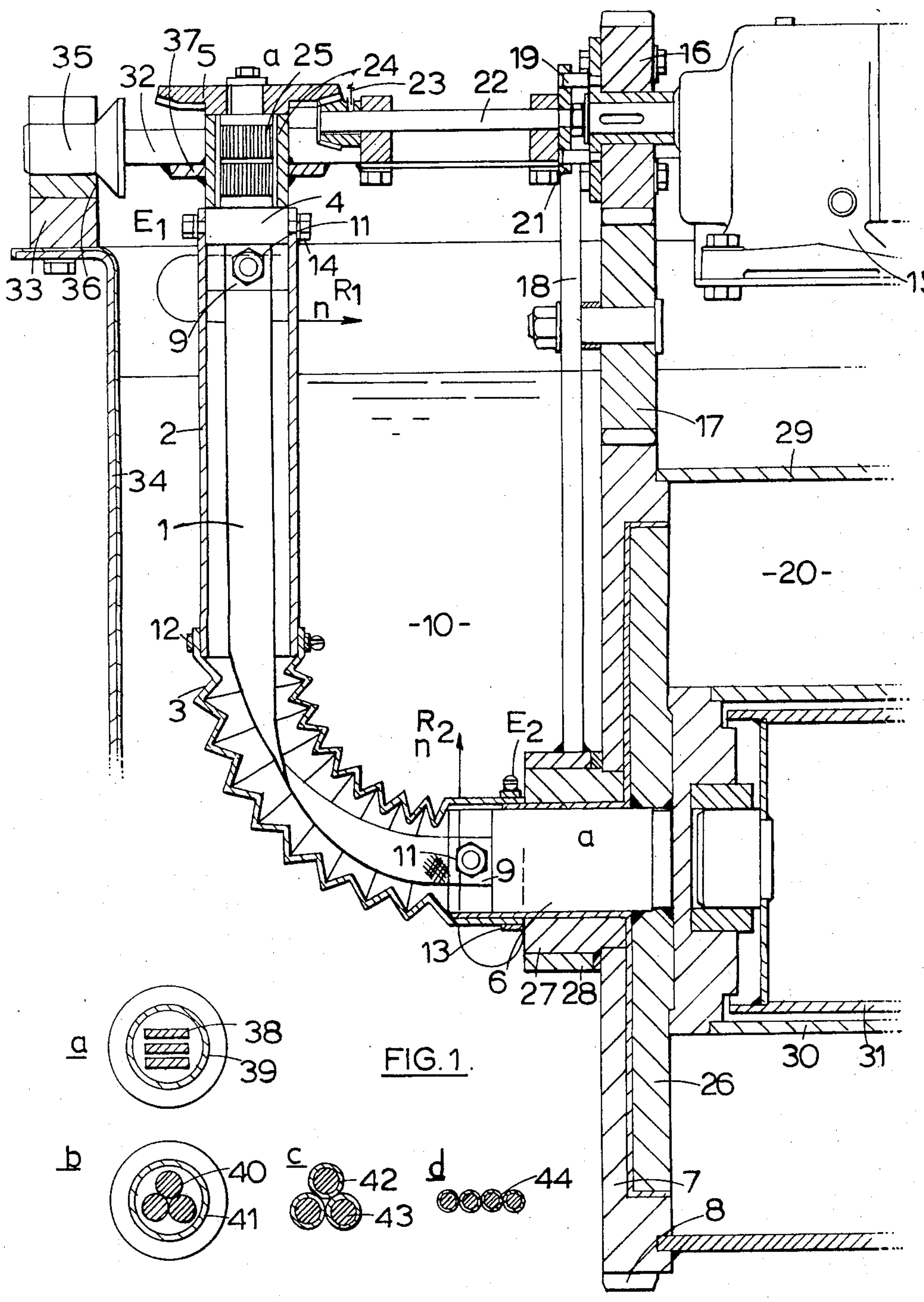

FIG. 1.

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CURRENT LEAD-IN DEVICES FOR CONTAINERS EMPLOYED IN ELECTROLYTIC TREATMENTS

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ABSTRACT OF THE DISCLOSURE

A current lead-in device for supplying direct current to rotatable electrolytic containers, especially tumbling barrels for electroplating metal or plastics parts in bulk, consists essentially of a flexible conductor surrounded by a flexible casing which is electrically insulating and chemically resistant against the electrolyte, and also includes means for rotating the conductor synchrously with the container, operative upon the conductor at two or more points spaced apart thereon, usually above all the ends thereof.

This invention relates to certain new and useful improvements in or relating to current lead-in devices for containers employed in electrolytic treatments.

BACKGROUND OF THE INVENTION

For various purposes it is well-known to subject articles to electrolytic treatment within rotating containers partially or wholly immersed in electrolytes. Probably the most common example of such procedures is to be found in the bulk electroplating of masses of small parts—either metallic or plastic—in rotatable, perforated tumbling barrels. Such tumbling barrels and other electrolytic containers are provided with means whereby they may be rotated while completely or partially immersed in electrolytes, and must also be furnished with current lead-in devices for conducting current to or from the metal or plastics tumbleable bulk parts within the barrel—or to or from whatever other article is within the container. Although from here onwards the invention and its background will be described mainly from the aspect of electroplating small parts in bulk within a tumbling barrel, it should not be forgotten that mutatis mutandis the same principles apply when subjecting other articles to other electrolytic treatments in other containers.

In the bulk-electroplating of a mass of small metal or plastics parts these are charged into perforated tumbling barrels which are partly dipped or wholly immersed in the electrolyte and are rotated therein while a cathodic potential (or, when undertaking electrolytic polishing, an anodic potential) is applied to the mass of small parts, of opposite electrical sign to that of the corresponding potential applied to the electrodes positioned outside the tumbling barrel. Thus it can be seen that an electric current must be conducted from the negative or positive pole of a direct current source located outside the electrolyte to the bulk mass of small parts within the rotating tumbling barrel immersed in the electrolyte.

It is known to manufacture the arms which support the tumbling barrel in the electrolyte from plastics. Then conduction of the direct current to the charge of bulk parts within the barrel takes place mainly via flexible cables, both chemically and electrically insulated against the electrolyte, which are inserted into the interior of the tumbling barrel through the bearing apertures and terminate in metallically-bright so-called contact knobs. This construction has the disadvantage that the contact knobs which have to contact the bulk parts do not rotate synchronously with the tumbling barrel and consequently are not suitable for electrically contacting a large number of bulk parts.

Attempts however have been made to achieve synchronous rotation of the tumbling barrel and of the contact elements located therein. One familiar arrangement provides a flexible and insulated cable with its lower end fixedly connected with one end wall of the rotating barrel, usually below the level of the electrolyte. The fixed lower end of the cable is fastened to the centre point of the rotation of the end wall, normal to the axis of rotation. The other, upper end of the cable is located outside the electrolyte, and is journalled and rotates in a shell bearing via which the current from the direct current source is transferred to the end of the cable rotating therein. The two ends of the cable are at right-angles to one another, and consequently the cable forms a quadrant, both ends of which are in some sense held but only one of which ends—the one fixed to the end wall of the tumbling barrel—is rotationally driven. That drive from one end only of the cable has to overcome all the resistance of the continually-occurring deformation of the arcuate cable as well as the friction which occurs throughout the whole cable system; and from this it necessarily follows that the cable inevitably is torsionally stressed. Such frictional forces, accentuated by any counter-acting torques which may arise from any momentary jamming of the upper end of the cable in the bearing, mean that in use the flexible, insulated cable tends to deform to an irregular helix. This gives rise to combinations of shearing, bending, tensile and compressive stresses in the cable—whose core usually is plaited or otherwise constructed from thin copper wires characterized by extremely low mechanical strength. Practical experience shows that such cables have only a short service life, and must be changed frequently. Breaks in such cables caused by repeated loading which of course will vary from case to case, will quite often occur after only a few days' use.

Another form of known tumbling barrel includes supporting arms which are made of solid round steel bars bent through a quarter-circle—from the vertical to the horizontal—at their lower ends. The stumpy horizontal lower ends of the arms form the journal bearing and the co-acting metallic bearing bushes are positioned in the end walls of the rotating tumbling barrels. With this construction the direct electric current for the electrolytic process is conducted through the steel support arms, and is transmitted via the bearing bushes mounted on the journals to suitable contact elements which establish contact with the bulk parts to be electroplated within the tumbling barrel. With this arrangement the insulation of the supporting arm and of the bearing bush against the electrolyte, both chemically and electrically, is achieved by means of flexible bellows, made of a plastics material, which is rigidly fixed to the end wall of the tumbling barrel and rotates synchronously therewith. The transfer of the current from the bearing journal to the bearing bush rotating thereupon takes place at a point normally below the level of the electrolyte, and which thus has to be insulated. Measurements have shown that with the usual electroplating currents of around 500 a., the voltage drop which has to be expected at the sliding current-transfer interface may well be greater than 40 mv.; and calculation (500 a.$\times$40 mv.=20 w.) immediately shows that the known bearing represents a heat source of significant magnitude. Although the sliding current-transfer interface is a significant heat source, yet nevertheless it must for fundamental reasons be kept chemically and electrically insulated against the surrounding electrolyte by areas of electrical nonconductors, thus in practice employing some plastics material, which will be a bad heat conductor. Consequently, the heat generated at the journal bearing is not readily dissipated and high temperatures build up on the metallic journal bearing and the metallic bearing bush, which—dependent of course upon the strength of the current—quite often lead to burning of the lubricant as well as damage to the flexible insulating bellows. Moreover, any formation of metal oxides upon the two sliding surfaces of the journal bearing and of the bearing bush, which is the more likely as the temperature rises, will cause a further increase in the localized electrical resistance, and consequently a further increase in the temperature. As the bearings become unusable they must be changed, at considerable expense—which becomes unacceptable when they must be changed at very short intervals of time.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a current lead-in which is simple and sturdy in construction, effective for long periods in service, and easy to replace when necessary, and which thus overcomes most or all of the disadvantages of known constructions.

According to the invention there is provided a current lead-in, for supplying electric current to a perforate container when completely or partially immersed in an electrolyte, above all for feeding direct current to tumbling barrels for bulk electroplating of small tumbleable parts made of metals or plastics, comprising in combination a flexible conductor and an insulating casing, surrounding said conductor along its length and formed of an insulating material both electrically and chemically resistant to the electrolyte, as well as means whereby said flexible current conductor is to be attached fixedly to the immersed container adjacent its rotational axis for rotation about the conductor axis synchronously therewith, and means operatively associated with said flexible current conductor at more than one point along the conductor axis whereby said flexible conductor may in operation be rotationally driven at said points synchronously with the rotation of the immersed container.

It will be seen that the current lead-in according to the invention is rotated synchronously with the immersed container by means of rotary drive mechanisms acting in at least two different places along its axis of rotation, and rather surprisingly it has been found that this arrangement does not permit any significant mechanical torque to be set up in the form of destructive torsions between any two points at which the rotational drive is applied to the lead-in conductor. It is preferred usually to provide two synchronous rotational drives, each of them adjacent different ends of the flexible conductor.

The current lead-in according to the invention is formed primarily of a flexible metallic conductor and its insulating casing. While the term "flexible" as used herein relation to the conductor may cover articulated structures of all kinds, it is intended primarily to refer to plaited strips of the well-known kind. The insulating casing surrounds the conductor concentrically, and consists of a material which is electrically non-conductive and is sufficiently resistant, both chemically as well as thermally, against the surrounding electrolyte.

The current lead-in according to the invention embraces various possible constructional variations, for instance embodiments wherein the conductor filaments are gathered into either one or more bundles, and/or wherein the overall cross-sectional shape of the conductor is not only rectangular but also elliptical, circular or even irregular, and/or wherein the conductor includes further added components, such as flexible drive-shafts, open-link chains, etc., for mechanically supporting the current conductor or for transmitting the driving torque along the length thereof.

The conductor strips used, which may be of any desired cross-sectional shape, even circular, are best made up from highly flexible copper wires of small diameter—of the order of magnitude of 0.10 mm.—and fastened together at their ends in seamless tag-lugs, thus by pressing and without solder. The conductor strips to be used according to the invention can often conveniently be the heavy-duty, mains current cables for direct current, used in electrical engineering, whose core usually consists of a bundle of several conductor cords, which can then be insulated in a liquid-tight manner with an elastic casing formed of an electrical non-conductor.

It has been found to be usually most advantageous to position the rotational drive mechanisms at or adjacent the two ends of the current conductor. The two rotational drive mechanisms, operating at two different points along the axis of the current conductor, must be synchronized; and this may most conveniently be achieved by using a single motor source (for instance an electro-motor) for the two rotational drive mechanisms, each of which is driven therefrom via a gear wheel associated with the tumbling barrel. Obviously, however, the driving system need not be the suggested gear-train, but this may be replaced partially or completely by V-belts or by chains and sprocket-wheels, or by any other similar components.

The current lead-in device of the invention makes it possible for the flexible conductor to hang loosely between its two locally fixed but synchronously rotating ends, taking up a position which corresponds to half a parabola whose major axis is vertical; in practice the two ends of the flexible conductor will usually be at right angles. The fact that there are rotational drive mechanisms operating synchronously but independently of one another at both ends of the conductor ensures that it remains free from torsional stresses, which surprisingly seems to enable its service life to be extended to a practically unlimited degree, making operational failures very rare.

It has proved convenient to fasten the lower end of the current conductor at the centre of rotation of one of the two end-walls of the tumbling barrel, while the other, upper end of the conductor is preferably positioned outside the electrolyte, and is likewise rotated synchronously with the barrel—obviously in the same direction of rotation. The upper end of the current conductor rotates in a bearing bush, but this if outside the electrolyte need not be insulated in such a way as to interfere with heat dissipation, while anyway it is preferred that the transfer of the current to the end of the conductor should be kept dissociated from its mechanical bearing, and instead is arranged to take place via special sliding members.

The current conductor according to the invention has shown itself to be excellent for all kinds of tumbling barrels and other electrolytic containers which cannot use so-called contact-knobs (at the end of flexible cables introduced into the inside of the container through the bearing aperture) for conveying current to anything located therein.

It is especially preferred if the insulating plastics casing is freely movable relative to the flexible metallic conductor. When the current lead-in device as a whole hangs freely in a curve between its two clamped ends, upon rotation of the current conductor about its axis of rotation then local partial relative movements must tend to occur between the flexible metal strip and the surrounding insulating casing, and if these can take place freely this will prove to be advantageous. Such freedom of axial movement of the casing relative to the conductor can best be achieved by leaving a concentric space intermediate the two components.

It is also possible within the scope of the invention to form the flexible current conductor with a rectangular cross-section whose width is considerably greater than its height. Such a flat conductor strip can be more easily bent than most other shapes, and consequently permits this conductor—which mostly must turn through a right angle—to be bent sharply, with quite small radii of curvature. Furthermore, if one twists one of the two ends of such a flat current conductor strip through 180° with respect to the other, then the rotational movement of the current lead-in device proceeds, even when its axis turns through a right angle, particularly smoothly and peacefully; the distances between the furthest-apart points on the twisted and rotating current conductor srip—thus the distance between the diagonally-opposed corners of the conductor strip of rectangular outline—will in this case remain practically the same in each rotational position.

Another possibility within the scope of the invention is to use a round cable, i.e. one of circular cross-section, which is built-up of thin, highly-flexible copper wires (or cords made of copper wires) which individual wires or cords are laid upon one another in such a way that they form helices about and so-to-speak parallel to the axis of rotation of the round cable. A cable thus constructed when used as the flexible conductor is especially smooth in operation when its operative position is right-angled, because the distances between the ends of its wires remain always constant—just as when using a flat and flexible current conductor whose ends are displaced by 180° with respect to one another.

Tumbling barrels which incorporate a concentrically-positioned inner cylinder presents a particularly difficult problem when seeking to conduct the direct current to cathodic contact members located in the annular space between the inner cylinder and the outer housing of the barrel. The current lead-in device according to the invention, however, fulfils the requirements for this. The lower end of the conductor is fixedly connected to the end wall of the barrel housing, at or closely adjacent its centre of rotation, and is covered with an insulating casing; while conduction of the current the rest of the way from the point of connection can easily be effected through the end wall in such a way that it is distributed radially to the cathodic contact members in the annular space within the barrel.

A still further possibility within the scope of the invention is to build up the current lead-in device from a number of essentially parallel conductors, each individual conductor being provided with its own insulating casing—and preferably with the individual conductors in the resultant bundle arranged in the form of a helix. With this kind of arrangement the lower ends of the conductors can each individually be fixed to the end wall of the barrel—of course, as before, at or adjacent its axis of rotation; but the upper end of the bundle is best fixed, in a similar manner, to a rotating disc or the like, located outside the electrolyte, which can be rotated synchronously with the end wall of the barrel. Clearly it is also possible to enclose the whole of such a bundle of conductors within a common and all-enveloping insulating casing.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be well understood it will now be further explained, though only by way of illustration, with reference to the accompanying drawings, in which:

FIG. 1 proper shows a part-sectional, part-elevational view, in a vertical plane, of a current lead-in arrangement in accordance with this invention serving a tumbling barrel, rotatable about a horizontal axis, for the bulk electro-plating of metallic or non-metallic parts;

FIG. 1*a* is a cross-sectional view, taken at right-angles to the longitudinal axis, through one preferred embodiment of the current-lead shown in FIG. 1;

FIG. 1*b* is a similar cross-sectional view through another preferred embodiment of the current-lead shown in FIG. 1; and

FIG. 1*c* is a similar cross-sectional view through a yet further preferred embodiment of the current-lead shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As can best be seen from FIG. 1, the current lead-in—which as a whole unit is there designated with the reference 10—consists fundamentally of a metallic conductor **1** and its insulating casing **2**, **3** and rotates about a non-linear axis *a—a*. As shown in FIG. 1, the metallic conductor **1** is a flexible, relatively flat strip, such as can be plaited from thin, highly flexible copper wires about 0.10 mm. in diameter.

The conductor is surrounded by a substantially co-axial insulating casing **2**, **3** formed of course of an electrically non-conductive material, which must also be reasonably resistant to damage of chemical and/or thermal origin caused by its immersion in the electrolyte. As shown in FIG. 1, the insulating casing consists essentially of two parts; the upper, vertical part projecting above the electrolyte is a pipe **2** made of a hard polyvinyl chloride (or of another similar thermoplastic), while the lower part—which turns through a right-angle and may well be immersed in the electrolyte—is a tubular member preferably (as shown) of bellows-type construction and formed of a soft, flexible material such as polyvinyl chloride, polychloroprene or natural rubber. It will be appreciated that the use of such a soft, flexible and indeed elastic material at this point enables the repeated deformations, which result from the right-angled position of the bellows **3** during continuous rotation about the curved axis of rotation *a—a*, to be readily accommodated.

The tumbling barrel to which the current lead-in arrangement is attached is as a whole generally designated with the reference **20**. It is a feature of this invention that the tumbling barrel **20** and also the attached current lead-in unit **10** rotate synchronously with some common speed of rotation n. For guidance it may be noted that in practice a commonly-employed speed of rotation is for instance 4 revolutions per minute.

The current lead-in is in fact rotated by two rotational drive mechanisms R_1 and R_2 which both rotate the current lead-in device **10** at a speed of rotation n, in the same direction of rotation and synchronously (with the attached drum **20**), but at two different points E_1 and E_2 on its axis of rotation *a—a*. While other arrangements are possible, it has been found usually best within the scope of the invention, to arrange the rotational drive mechanisms R_1 and R_2 at the two ends E_1 and E_2 of the current lead-in device **10**.

The two rotational drive mechanisms R_1 and R_2, as well as their directions of rotation, are shown only schematically by the arrows in FIG. 1. Naturally, the rotational driving moments act in planes normal to the axis *a—a* of rotation. In the preferred embodiment shown, the rotational axis *a—a* of the current lead-in is turned through a right angle and therefore its two ends—designated by the symbols E_1 and E_2—are also normal to one another. Thus it will be seen that the rotational drive mechanisms R_1 and R_2 operate at different points along the axis of rotation *a—a*, and as shown specifically at the ends E_1 and E_2 of the current lead-in device **10**.

The end E_1 is connected to a shaft **4**, which is secured to and rotated by the bevel gear **5**. The end E_2, on the other hand, is connected to the axle **6** of the tumbling barrel, and is in fact rotated by the end-wall **7** of the barrel **20**, which is provided at its periphery with teeth **8** and acts as a gear wheel.

The current conductor strip **1** is fastened at each of its two ends, without solder, by clamping into the tag-lugs **9**, and these in turn are secured to the stumps of respectively the shafts **4** and **6**, by means of screw connectors **11**.

The current conductor strip **1** hangs freely—like a cord—between its two locally fixed and in operation synchronously-rotating ends in the tag-lugs **9**. The curve adopted by the strip **1** corresponds approximately to that of half a parabola whose longitudinal axis is vertical. The fact that the drive mechanisms R_1 and R_2 rotate the conductor strip **1** synchronously at both of its ends means that the flexible current conductor strip **1** remains completely free from torsional stresses, and as a result can hope to enjoy a practically unlimited service life.

The flat conductor strip **1** has a rectangular cross-section, and it is best that its two ends, each clamped in one of the tag-lugs **9**, should be displaced with respect one to the other by 180°, so that there is always a twist in the strip. Then the flat-strip forms a kind of helix along its curved axis of rotation *a—a* and in these circumstances the distances between the further separated points in the bent and rotating flexible conductor strip **1** (thus for instance the distances between the diagonally-opposed corners of the generally-rectangular conductor strip **1**) remain virtually the same in every rotational position.

The flexible conductor strip **1** has a rectangular cross-sectional shape, with a width considerably greater than its height, thus constituting a very flat belt **1**, which is relatively easy to bend, and consequently permits the radius of curvature of the current lead-in device where it turns through a right-angle to be fairly small.

The two parts of the insulating casing **2** and **3**, are mechanically interconnected by means of a hose clip **12**, and thereby sealed against the entry of any of the surrounding electrolyte. Similarly, a liquid-tight connection is guaranteed between the other, lower end of the elastic casing-part **3** and the barrel axle **6** by means of another hose clip **13**. The upper end of the insulating pipe **2** is fastened to the driving shaft **4** by means of set-screws **14**. The end E_1 of the current lead-in **10** will preferably be located above the level of the electrolyte; it should be noted that the horizontal line in the upper region of FIG. 1 of the drawings is meant to symbolize the proper level of the electrolyte.

It will of course be appreciated that the insulating casing **2** and **3**, can instead also consist completely of a single, elastic element **3** (more particularly a bellows) which extends all the way from the lower end E_2 of the current lead-in **10** to its upper end E_1.

The rotational drive mechanisms R_1 and R_2 rotate the insulating casing synchronously at its two ends, which correspond effectively to the ends of the conductor **1**; consequently this arrangement of the rotational drive mechanisms R_1 and R_2 also minimizes or even eliminates torsional stresses between the ends of the insulating casing, and this guarantees a practically unlimited service life for it.

The insulating casing is preferably so dimensioned that it is well spaced from the conductor strip **1**, in order to avoid any friction between these two components during operation, and thus to ensure that the rotation of the conductor strip **1** about its curved axis *a—a* takes places without interference and therefore as favorably as possible.

The curve of the conductor strip **1** through a right-angle, thus through what might roughly be regarded as a quarter-circle, corresponds to the most commonly required set-up for the current lead-in **10**. FIG. 1 shows the connection of the current lead-in **10** to one of the two end walls **7** of the tumbling barrel unit **20**; but of course it is equally possible to attach a current lead-in **10** to each end wall **7** of the barrel **20**.

It will be noted that the current lead-in **10** is attached to the end wall **7** at or adjacent to its centre of rotation. The roational axis *a—a* of the current lead-in **10** and its geometrical axis of symmetry need not necessarily coincide. The same also applies to the end wall **7** of the barrel **20**; its axes of rotation and of symmetry can be different.

There are very many different ways in which the current lead-in **10** according to the invention can be attached to the end walls **7**. It is, for instance, possible to attach the flexible (or even non-flexible) conductor strip **1** to the end wall **7** of the tumbling barrel **20** via movable connections such as knuckle joints, ball-and-socket joints to similar components.

The two rotary driving mechanisms R_1 and R_2 are, in turn, driven by a single common drive—most conveniently as shown by the electromotor **15** associated with the tumbling barrel unit **20**. The gearwheel **16** mounted on the drive shaft of the geared motor **15** transmits the rotary drive via the intermediate gearwheel **17** to the toothed rim **8** of the tumbling barrel **20**. The intermediate gearwheel **17** is mounted on the supporting arm **18** of the tumbling barrel **20**. The gearwheel **16** is also connected—via a coupling formed by the bolts **19** and the disc **21**—with one end of the shaft **22**, at whose opposite end there is located the small bevel gear **23**. In turn the bevel gear **23** meshes with the bevel gear **5**, and consequently drives the shaft **4**. Accordingly, it can be seen that the motor **15** constitutes the driving force for both of the two rotary drive mechanisms R_1 and R_2. The transmission from the motor **15** to the rotary drive mechanisms R_1 and R_2 thus proceeds on the one hand via the sequence of gearwheels **16, 17** and **18**, as well as on the other hand via gearwheels **16, 23** and **5**. The corresponding transmission ratio for the individual pairs of gears is 1:4.

The shaft **4** of the rotary drive mechanism R_1 is journalled in the bushing **24**. The transmission of electrical current from the bushing **24** to the shaft **4** is effected—apart from any that passes through the mechanical bearing—via the coaxially-arranged, spring-loaded laminae **25**, which are preferably made of beryllium-bronze.

The batch of small parts in bulk, located inside the tumbling barrel **20**, comes into contact with the cathodic contact disc **26** within the barrel **20**—and thus both metal and plastics parts can be electroplated. The shaft **6** and the contact disc **26** are formed integrally with one another, and they are coated—up to their contact surfaces—with an electro-chemically insulating layer consisting of a thermoplastic or rubber. The journal of shaft **6** is surrounded by a concentric ring **27**, fixedly secured to the end wall **7**, and formed of an electrically non-conductive material with good anti-friction properties. This ring **27** in turn rotates in a bearing bush **28** carried by the supporting arm **18**.

The tumbling barrel **20** incorporates an inner cylinder **30**, mounted within its outer perforated casing, and itself preferably perforated. This inner cylinder **30** is made of a non-conductive material, but may possibly surround an inner anode **31**. The small parts in bulk, made of metals or plastics, which are to be electroplated then can be filled into the annular space between the barrel casing **29** and the inner cylinder **30**.

The current lead-in **10** according to the invention is moreover equally or even particularly suitable for use with tumbling barrels having cathodic contact elements in the form of knobs, strips or discs.

The motor **15**, the supporting arm **18**, the shaft **22** and the bearing bush **24** are all mounted upon a framework **32**, in such a manner that they—together with the current lead-in **10** and the tumbling barrel **20** —shall form a mechanical entity, which can be rested in position upon the reinforcing rims **33** of the electrolyte tank **34**. The supporting framework **32** at its horizontal extremities terminates in support bolts **35**, which are attached to the bearing surfaces **36**; these in turn are secured upon the tank rims **33**, and convey the direct electrical current to the support bolts **35**, and thence via the tubular framework **32** and the side bar or butt strap **37** which is welded onto the bearing bush **24** of the current lead-in **10**.

FIGS. 1*a*, 1*b*, 1*c* and 1*d* represent various possible alternative variations in the construction of the current lead-in according to the invention.

FIG. 1*a*, for instance, illustrates an arrangement of three parellely-placed, flat current conductor strips **38** within an insulating casing **39**. With this, as with the strip shown in FIG. 1, the ends of the current strips are likewise displaced (twisted) relative to one another by 180°, and the two externally located strips in the layer-like arrangement are somewhat longer than that enclosed in the middle.

FIG. 1*b* shows an arrangement of three conductors **40**, which are suspended helically inside an insulating casing **41**.

FIG. 1*c* shows a current lead-in essentially similar to that shown in FIG. 1*b*, but in which the three individual conductors **42**, each of circular cross-section, are instead, each provided with their own separate insulating sheaths **43**.

FIG. 1*d* illustrates a current lead-in consisting of four cables **44**, arranged side-by-side and combined into a strip.

It is well known that contact members (in the form of knobs, strips, etc.) which periodically lose contact (through the rotational movement of the barrel) with the mass of small parts in bulk which are to be electroplated, cause the electroplating current to be partially diverted from the bulk parts, and consequently reduce the electroplating output of the tumbling barrel quite considerably, often by about a quarter.

If however one employs the current lead-in according to the invention which consists of several cords **42** or **44**, electrically insulated from one another as shown in FIGS. 1*c* and 1*d*, then the shaft **4** can be constructed to function like a collector/commutator. Thus, each individual row of knobs or contact strips in the tumbling barrel can be electrically associated with one of the individual conductor cords **42** or **44**, and it can then be easily arranged that the cords **42** or **44** will not receive any current via the collector/commutator shaft **4**, if that row of knobs or contact strips can be expected—during the rotational movement of the barrel—to be located above the mass of small parts in bulk, and consequently to be out of electrical contact therewith.

Further embodiments of the invention provide for introducing components into the current lead-in **10** which primarily have certain mechanical functions to fulfill. Thus for example it is possible to envisage the use of flexible shafts, open-link chains, steel coils or titanium wires arranged in the form of helices, which can themselves carry the current either partially or even wholly but which serve mainly for mechanical support and/or for transmitting the rotary motion.

I claim:

1. A current lead-in, for supplying electric current to a perforate container, for the electroplating of small parts in bulk when the container is completely or partially immersed in an electrolyte, comprising in combination a flexible conductor and an insulating casing surrounding said conductor along its length and formed of an insulating material both electrically, chemically and thermally resistant to the electrolyte, as well as means whereby said flexible current conductor is to be attached fixedly to the immersed container adjacent its rotational axis for rotation about the axis of said conductor synchronously therewith, and means operatively associated with said flexible current conductor at more than one point along the conductor axis whereby said flexible conductor may in operation be rotationally driven at said points synchronously with the rotation of the immersed container.

2. A current lead-in as claimed in claim **1**, in which two synchronous rotary drives are provided, one at or adjacent each end of the rotational axis of the flexible conductor.

3. In an electroplating or electro-polishing installation including a tumbling barrel for small tumbleable parts made of metals or plastics and a current lead-in to said tumbling barrel, the improvement which comprises forming said current lead-in from a flexible conductor in combination with an insulating casing surrounding said conductor along its length and formed of an insulating material which is electrically, chemically and thermally resistant to electrolyte as well as means whereby said flexible current conductor is to be attached fixedly to the immersed container adjacent its rotational axis for rotation about the conductor axis synchronously therewith, and means operatively associated with said flexible current conductor at more than one point along the conductor axis whereby said flexible conductor may in operation be rotationally driven at said points synchronously with the rotation of the immersed container.

4. An installation as claimed in claim **3**, in which the synchronous rotary drives are themselves adapted to be driven from a common source.

5. An installation as claimed in claim **4**, in which the common source for the synchronous rotary drives operative upon the conductor serves also as the drive for the rotation of the tumbling barrel.

6. An installation as claimed in claim **5**, in which the axis about which the conductor rotates is curved between its ends.

7. An installation as claimed in claim **6**, in which the axis turns through a quarter-circle between ends set at right-angles to each other.

8. An installation as claimed in claim **7**, wherein the end of the conductor which is electrically-connected to the tumbling barrel is fixed to the end wall thereof and thus rotates synchronously with said end wall while the other end of the current conductor is freely rotatably journalley in a bearing bush mounted above the electrolyte.

9. A current lead-in as claimed in claim **1**, wherein the current conductor is composed of flexible filaments, wires or cords arranged helically about and parallel to its axis of rotation.

10. A current lead-in as claimed in claim **1**, wherein the current conductor is composed of a bundle of at least two conductors each individual conductor being provided with its own insulating sheath.

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F. C. EDMUNDSON, Primary Examiner

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,799,858 Dated March 26, 1974

Inventor(s) Hans Henig

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

Claim 8, line 6, "journalley" should be:

- journalled -

Signed and sealed this 9th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents