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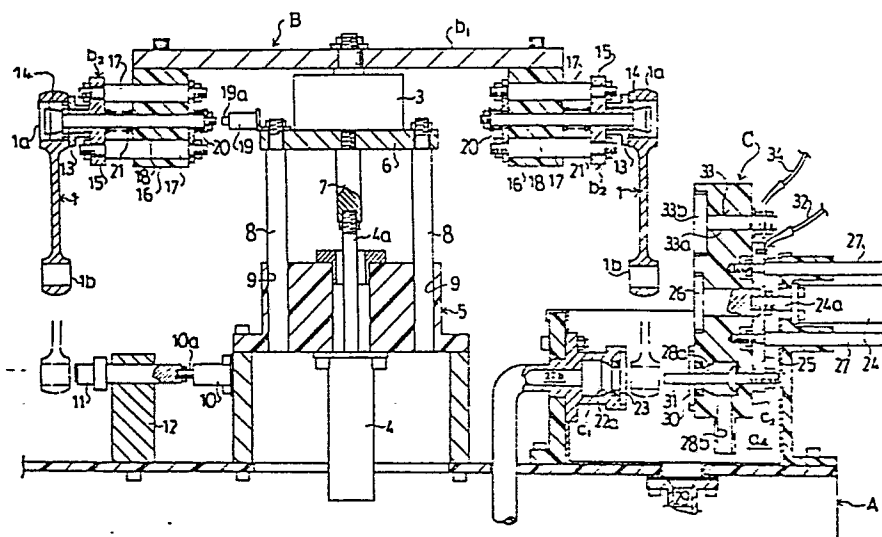
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54 High speed plating apparatus.

57 A high speed plating apparatus for automatically and efficiently plating of work pieces has a plating chamber for accommodating a work (1) to be plated and a transfer machine (B) for transferring said work into and out of said plating chamber. The plating chamber is defined by a pair of walls ($c_1; c_2$) which can be joined and separated from each other for forming the plating chamber. When joined together, the resulting plating chamber has its wall equipped with a plating electrode. The transfer machine (B) is used for stopping said work piece for a predetermined time period at a stage in which said work piece is accommodated in the plating chamber.

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1 The present invention relates to a high speed plating
apparatus and, more particularly, to an apparatus for consecutively
plating a number of works at a high speed. An object of the
5 present invention is to automatically and efficiently effect
the plating treatment and to reduce the size of the high speed
plating apparatus in order to reduce the area occupied thereby.

The present invention will now be described in connection
10 with one embodiment thereof with reference to the accompanying
drawings,

Fig. 1 is a top plan view showing an apparatus according
15 to the present invention; Fig. 2 is an enlarged section taken
along line II - II of Fig. 1; and Fig. 3 is a sectional view
showing the transferred state of the connecting rod used as
20 a work to be plated.

A connecting rod 1 to be used in an internal
combustion engine is shown as an example of a work to be plated
in the accompanying drawings.

25 The connecting rod 1 is formed with a larger end portion
1a, a smaller end portion 1b and holes, and the smaller end
portion 1b has its inner circumference plated with copper
in the present embodiment.

30 Reference letter A appearing in the drawings indicates
a treating bath for effecting a plating treatment, and treatments
before and after the plating treatment.

35 That treating bath is formed to have a round shape
in a top plan view and to have its portion recessed in a
sector shape thereby to form a notched portion 2 and its other

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1 portion radially divided into seven bathes a_1 , a_2 , a_3 , a_4 ,
5 a_5 , a_6 and a_7 .

The aforementioned notched portion 2 is a place in
5 which the connecting rod 1 is attached to or detached from
a later-described transfer machine B. The connecting rod 1
is clockwise transferred from the starting point of the notched
portion 2 by the action the transfer machine B until it is
10 again returned to that starting point.

Of the seven bathes a_1 to a_7 formed in the treating
bath A, on the other hand, the first bath a_1 , as viewed from
15 the notched portion 2 in the transferred direction of the
connecting rod 1, is stored with a deoiling liquid, which
is composed mainly of sodium hydroxide, thereby to effect
the deoiling treatment of the smaller end portion 1b of the
20 connecting rod 1.

Next, the second bath a_2 is stored with water thereby
to rinse away the deoiling liquid which has wetted the smaller
end portion 1b of the connecting rod 1 in the aforementioned
25 first bath a_1 .

The rinsing operation in the second bath a_2 is called
the "recovery rinsing operation" because the deoiling liquid
30 is recovered into the first bath a_1 .

Next, the third bath a_3 is stored with pure water
and has this pure water circulated a cleaner (although not
shown) thereby to effect the final rinsing operation of the
35 smaller end portion 1b of the connecting rod 1 as the treatment
prior to the plating operation.

1 The fourth bath a_4 is a bath for effecting the plating operation, in which the plating liquid is not reserved but a later-described plating apparatus C is accommodated.

5 The fifth bath a_5 is stored with water thereby to rinse the smaller end portion lb of the connecting rod l, which has been plated in the aforementioned fourth bath a_4 .

10 The sixth bath a_6 is stored with pure water thereby to rinse away the plating liquid which is left unremoved by the rinsing operation in the aforementioned fifth bath a_5 . The plating liquid thus rinsed away is allowed to overflow until it is returned to the fifth bath a_5 .

15 Thus, the rinsing operations in the aforementioned fifth and sixth bathes a_5 and a_6 are called the "first and second rinsing operations", respectively, because the plating liquid is recovered.

20 Next, the seventh bath a_7 is stored with pure water and has this pure water circulated through a cleaner (although not shown) thereby to effect the final rinsing operation of the smaller end portion lb of the connecting rod l as the treatment after the plating operation.

30 On the other hand, the aforementioned transfer machine B is concentrically disposed above the center of the aforementioned treating bath A and is constructed of a disc-shaped turntable b_1 and a clamping mechanism b_2 which is disposed at the outer circumferential portion of the lower side of the turntable b_1 .

 The motor 3 is made operative to intermittently feed the turntable b_1 clockwise a predetermined angle and is placed

1 on a platform 6. This platform 6 is so constructed that it
slides up and down above a frame 5 through guide rods 8 and
is connected through a rod 7 to a hydraulic or pneumatic
5 cylinder 4 which is connected to the lower side of the frame 5.

Reference numeral 10 indicates a hydraulic or pneumatic
cylinder which is connected to the side of the frame 5 and
which has its rod 10a connected to a locate pin 11. This
10 locate pin 11 is fitted, when in its protruding position,
in the smaller end hole of the connecting rod 1 thereby to
position the connecting rod 1 such that the latter vertically
15 depends.

On the other hand, the aforementioned clamping
mechanism b_2 is composed of eight sub-mechanisms which are
equidistantly arranged to correspond to the notched portion 2
20 and the respective bathes a_1 to a_7 of the treating bath A
thereby to retain and clamp the connecting rod 1 at its larger
end portion 1a.

Numeral 13 indicates a chuck, e.g., a collet chuck
25 of the known type, which has its leading end portion divided
in an opeable manner through a slit 14 and its base portion
screwed on a supporting member 15.

30 This supporting member 15 can be supported through two
guide rods 17 in a manner to move back and forth radially of
the turntable b_1 upon a support 16, which is fixed to the
lower side of the turntable b_1 , so that the leading end portion
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1 of a control rod 18 is urged by the action of a spring 20 to
push the leading end portion of the chuck 13, whereby it opens
outward the chuck 13 thereby to hold the larger end portion
5 1a of the connecting rod 1.

On the other hand, the release of the support by
the chuck can be effected by pushing the aforementioned control
rod 18 outward, i.e., in the direction to protrude from the
10 chuck 13 by the action of the hydraulic or pneumatic cylinder
which is mounted on the platform 6 of the aforementioned
motor 3.

15 Numeral 21 indicates a spring which is made operative
to bias the aforementioned supporting member 15 in a direction
apart from the support 16.

On the other hand, the plating apparatus C, which is
20 mounted in the fourth bath a_4 of the aforementioned treating
bath A, is constructed of a pair of wall members c_1 and c_2
which are so arranged to face each other that they can move
toward and apart from each other.

25 Those wall members c_1 and c_2 are disposed in the bath
 a_4 thereby to clamp the smaller end portion 1b of the connecting
rod 1 inbetween from both its sides. One wall member c_1 has
30 its wall surface opened to form a plating liquid supply
passage 22b, whereas the other wall member c_2 has its wall
surface opened to form a recovery passage 28a so that the
plating chamber including the inner surface of the smaller
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1 end portion of the connecting rod 1 therein is provided when
the two wall members c_1 and c_2 are closed. Numerals 23 and
30 indicate seal members which are disposed on the abutting
5 portions against the smaller end portion 1b of the connecting
rod 1. Those seal members 23 and 30 are made of rubber or
a soft synthetic resin thereby to hold the liquid-tightness
between an opening 22a and the smaller end portion 1b.

10 On the other hand, the other wall member c_2 is made
of a material having an insulating property such as a synthetic
resin.

15 Numeral 24 indicates a hydraulic or pneumatic cylinder
which is fixedly attached to the outer surface of the outer
wall of the bath a_4 and which has its rod 24a extending through
the outer side wall of the bath a_4 until it is connected to
20 the wall member c_2 through a conducting member such as a
mounting plate 25 and a connecting shaft 26, which are made
of aluminum.

25 As a result, the wall member c_2 is displaced in
accordance with the operation of the aforementioned cylinder
24 so that it can move toward and away from the facing wall
member c_1 .

30 Numeral 27 indicates guide rods which are made operative
to guide the operation of the aforementioned wall member c_2 .

As a result, the aforementioned supply passage 22b
and recovery passage 28b are connected at a state, in which
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1 the wall members c_1 and c_2 clamp the smaller end portion 1b
of the connecting rod 1, through said smaller end portion 1b
and through the openings 22a and 28a opened toward both the
5 ends of the former.

Numeral 29 indicates a communication passage which
is opened in the bottom of the bath a_4 and connected with
the aforementioned plating tank thereby to recover the plating
10 liquid from the recovery passage 28 into the plating liquid
tank.

Numeral 31 indicates an electrode which is so disposed
15 in the aforementioned opening 28a as to protrude from the
inner side of the wall member c_2 . That electrode 31 is
inserted into said smaller end portion 1b, at the state in
which both the wall members c_1 and c_2 clamp the smaller end
20 portion 1b of the connecting rod 1, and is usually connected
with the plus terminal of a power source.

Numeral 33 indicates an electrode member which is
buried in the upper portion of the wall member c_2 thereby to
25 connect the connecting rod 1 with the minus terminal of the
power source.

As a result, the connecting rod 1 to be plated acts
30 as the minus electrode, whereas the electrode 31 into which
the smaller end portion 1b of the connecting rod 1 is inserted,
acts as the plus electrode so that the smaller end portion 1b
of the connecting rod 1 has its inner circumference electrolytically

1 plated.

In the first bath a_1 of the aforementioned treating bath A, incidentally, there is disposed a deoiling bath D which has a construction substantially similar to that of the aforementioned plating apparatus C so that the deoiling treatment becomes the so-called "electrolytically deoiling treatment".

10 More specifically, the smaller end portion 1b of the connecting rod 1 is wholly deoiled by being dipped in the deoiling liquid of the bath a_1 and then has its inner circumference electrolytically deoiled.

15 In the deoiling apparatus D thus far described, the deoiling liquid is supplied to the smaller end portion 1b of the connecting rod 1 by way of the openings 22a and 28a of the wall members d_1 and d_2 of that apparatus D and by way of the supply and recovery passages 22b and 28b communicating with those openings 22a and 28a, and the connecting rod 1 acts as the plus electrode whereas the electrode 31 acts as the minus electrode so that the electric current flows in the direction opposite to that of the plating treatment.

25 Thus, the inner circumference of the smaller end portion 1b of the connecting rod 1 is electrolytically deoiled, as has been described hereinbefore, so that its deoiling treatment can be effected within a short time period and without fail.

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1 In the plating apparatus thus constructed, the connecting
rod 1 is attached to and held on the clamping mechanism b_2 in
the notched portion of the treating bath A.

5 More specifically, the the connecting rod 1 has its
larger end portion 1a fitted and held in the chuck 13 of the
clamping mechanism b_2 and its smaller end portion 1b fitted
in the locate pin 11 so that it is held in position in the
10 transfer machine B.

Moreover, the turntable b_1 is lifted by the cylinder
4 and is then turned by the motor 3 thereby to transfer the
15 connecting rod 1 from the notched portion 2 to the first
bath a_1 .

When the connecting rod 1 is brought to a position
above the first bath a_1 , the turntable b_1 is again moved down
20 by the cylinder 4 so that the smaller end portion 1b of the
connecting rod 1 is deoiled in that bath a_1 .

When in the aforementioned deoiling treatment, on
the other hand, a new connecting rod 1 is attached to and
25 held in the clamping mechanism b_2 corresponding to the notched
portion 2.

This attachment of the new connecting rod 1 is similarly
30 performed during each of the later-described respective
treatments so that the plating treatment, the pretreatment
and the posttreatment of the connecting rod 1 are simultaneously
effected in the respective bathes a_1 to a_7 .

1 After the deoiling treatment, moreover, the turntable
b₁ is again lifted and turned to transfer the connecting rod
1 to the second bath a₂.

5 Next, the turntable b₁ is moved down so that the smaller
end portion lb of hte connecting rod 1 is rinsed. After this
rinsing operation, the turntable b₁ is again lifted and turned
to transfer the connecting rod 1 to the third bath a₃, in
10 which the connecting rod 1 is rinsed.

After the three pretreatments thus far described, the
connecting rod 1 is plated in the fourth bath a₄.

15 At a state in which the smaller end portion lb of
the connecting rod 1 is accommodated in the bath a₄, more
specifically, the wall member c₂ at the movable side is pushed
by the cylinder 24 toward the wall member c₁ at the stationary
20 side so that the smaller end portion lb of the connecting
rod 1 is clamped between the two wall members c₁ and c₂.

In accordance with the operation of the aforementioned
wall member c₂, on the other hand, the abutment member 33
25 carried on the wall member c₂ abuts atainst the larger end
portion la of the connecting rod 1 thereby to displace the
supporting member 15 toward the support 16 through said
larger end portion la against the action of the spring 21.
30

At a state in which the smaller end portion lb of the
connecting rod 1 is clamped between the wall members c₁ and
c₂, the plating liquid flows from the supply passage 22b and
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1 the opening 22a through the smaller end portion 1b into the
opening 28a and the recovery passage 28 thereby to plate the
inner circumference of said smaller end portion 1b.

5 During the aforementioned plating treatment, incidentally,
even if the plating liquid should leak out of the openings 22a
and 28a and the respective passages 22 and 28 of the wall members
10 c_1 and c_2 or out of the smaller end portion 1b, it is reserved
in the bath a_4 and prevented from being splashed to the outside.

Thus, if the plating treatment is finished, the supply
of the plating liquid is stopped, and the wall member c_2 at
15 the movable side leaves the wall member c_1 at the stationary
side. Accordingly, the supporting member 15 is urged to
leave the support 16 by the action of the spring 12 so that
the smaller end portion 1b of the connecting rod 1 leaves
20 the wall member c_1 at the stationary side.

Moreover, the turntable b_1 is lifted so that the
connecting rod 1 escapes from the bath a_4 until it is transferred
to the next fifth bath a_5 , in which it is rinsed.

25 Likewise, the connecting rod 1 is consecutively
transferred to the sixth and seventh baths a_6 and a_7 , in
which it is rinsed to finish the posttreatment.

30 Thus, after all the treatments have been finished,
the connecting rod 1 is again returned to the notched portion
2 of the treating bath A, in which it is removed at the
same state from the clamping mechanism b_2 and is replated by

1 a new connecting rod 1.

All the treating operations other than the attachment and detachment of the connecting rod 1 to and from the transfer machine B are automatically accomplished in the aforementioned manners, and the plural, i.e., seven connecting rods 1 can be treated, pretreated and posttreated simultaneously and continuously:

10 Since the present invention has the construction thus far described, the holes of the work and the openings formed in the respective clamping members are made to communicate by clamping the work from both the sides of the holes thereof
15 by means of the paired clamping members so that the plating liquid supply and recovery passages leading to those openings are made to communicate through those holes. Since the
20 electrodes are simultaneously inserted into the holes, moreover, the inner circumferences of the holes formed midway are electrolytically plated by supplying the plating liquid from the supply passage to the recovery passage so that the plating
25 treatment of the inner circumferences of said holes can be effected automatically and efficiently.

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1 CLAIMS

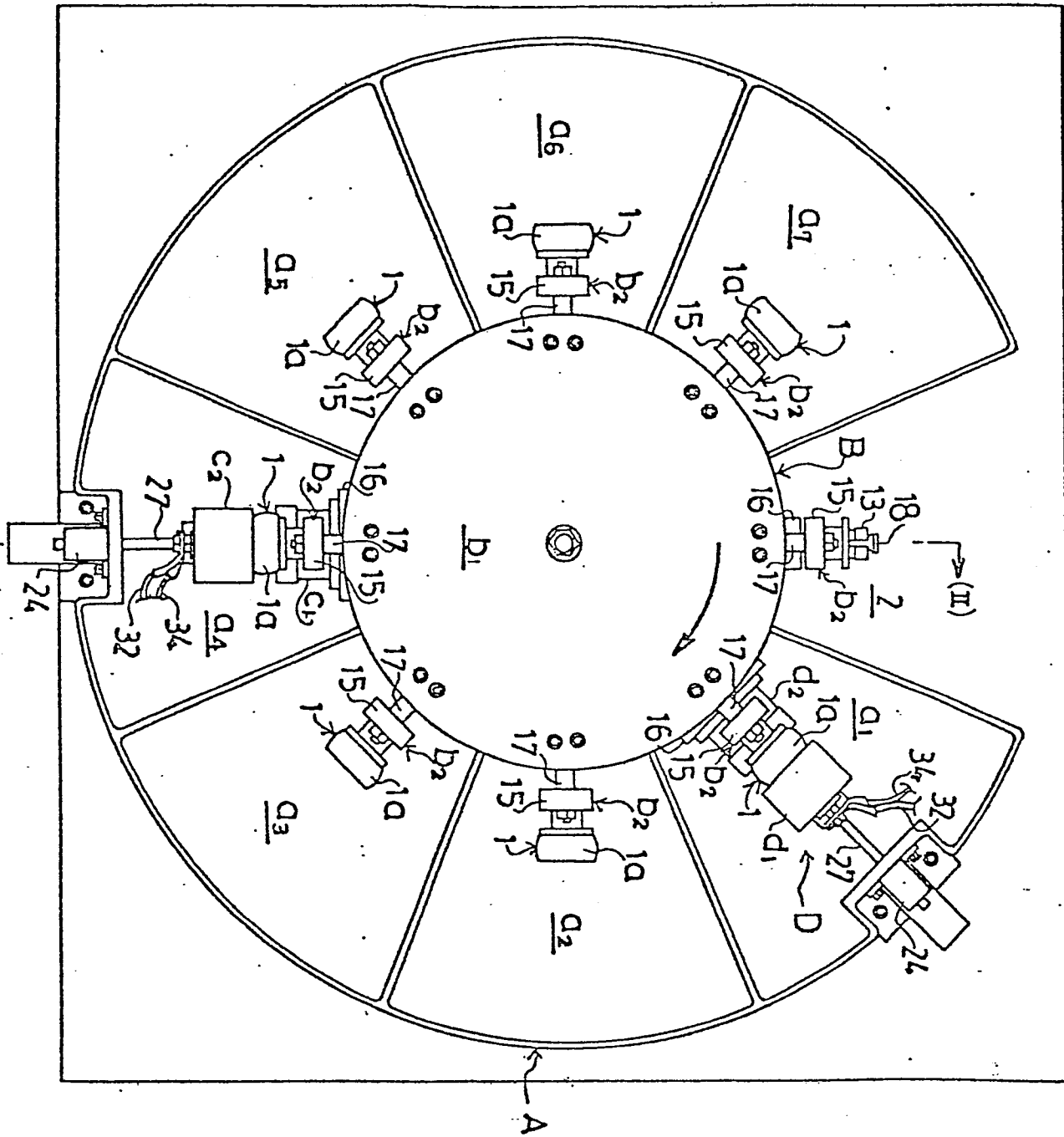
4. A high speed plating apparatus comprising a
plating chamber for accommodating a work (1) to be
5 plated and a transfer machine (B) for transferring
said work into and out of said plating chamber,
characterized by said plating chamber being defined
by a pair of wall members ($C_1; C_2$), which can be freely
jointed to and separated from each other thereby to
10 define said plating chamber therein when they are
jointed, said plating chamber having its wall equipped
with a plating electrode and plating liquid supply
(22b) and recovery (28) passages connected therewith,
said transfer machine (b) being enabled to stop said
15 work for a predetermined time period at a state in
which said work is accommodated in said plating chamber.

2. A high speed plating apparatus as set forth in
Claim 1, wherein said transfer machine is equipped
20 with means (b_2) for fixing said work.

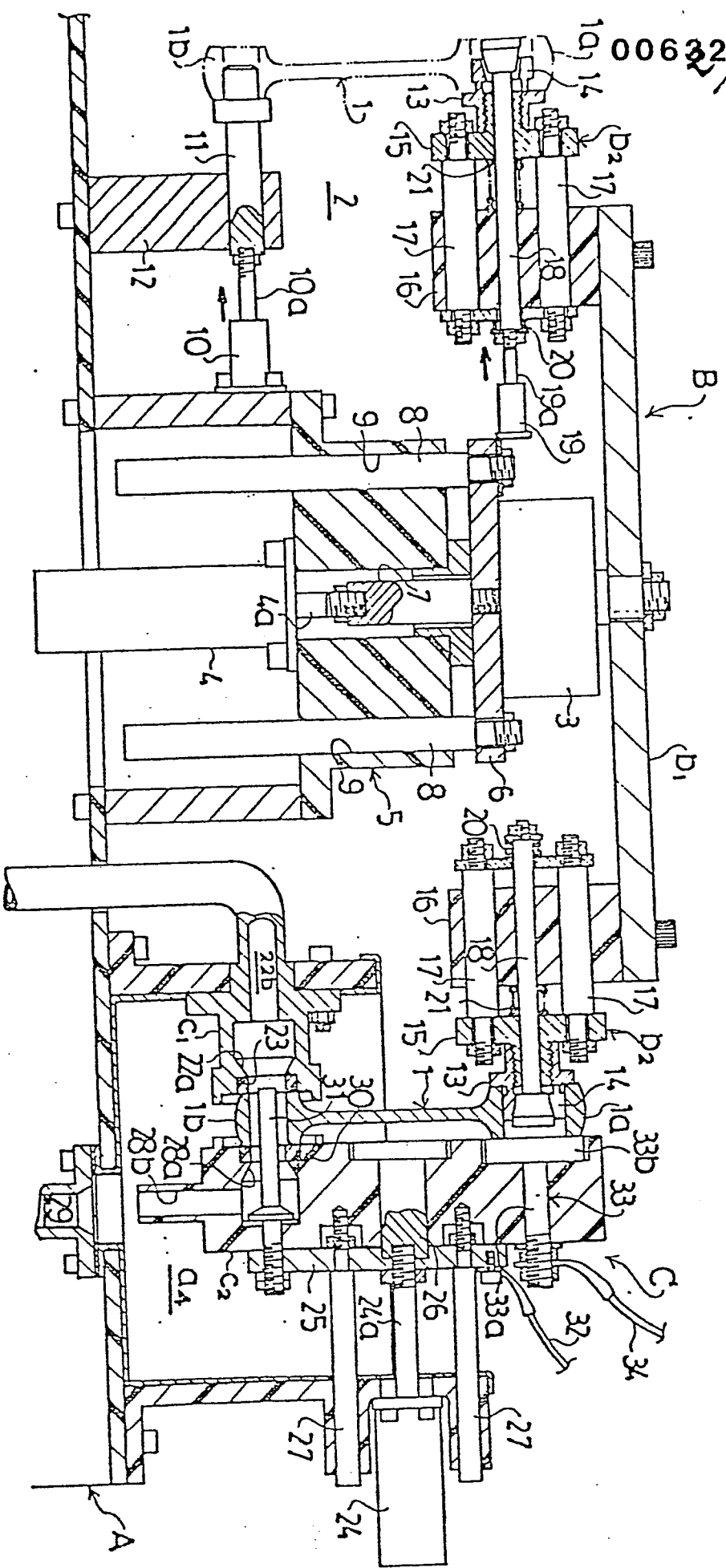
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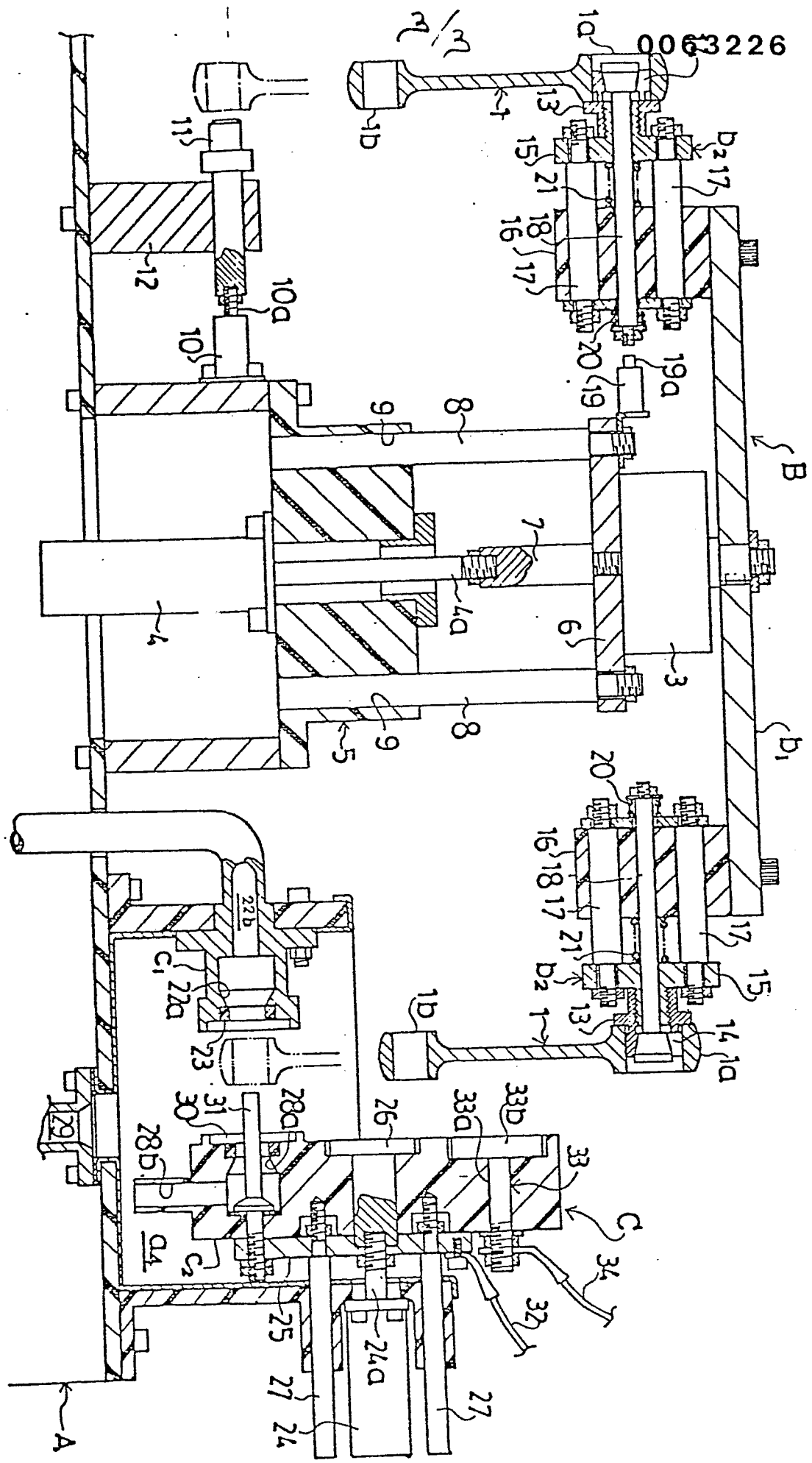
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European Patent
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EUROPEAN SEARCH REPORT

0063226

Application number

EP 82 10 1642

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. 3)
X	US-A-4 096 042 (LOONEY) *Figures 1,3; abstract* -----	1,2	C 25 D 7/04
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			C 25 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28-05-1982	Examiner NGUYEN THE NGHIEP
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	