Pulse power system for new industrial accelerator ILU-14

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Introduction

- Accelerators of ILU type.
- Pulse power source of ILU Accelerators.
- Accelerator ILU-14.
- HF generator structure of Accelerator ILU-14.
- Control system of pulse power source structure.
- Key features of three pulse power source structure.
ILU accelerators produced by BINP.

<table>
<thead>
<tr>
<th>Model</th>
<th>Energy range, MeV</th>
<th>Beam power, kW</th>
<th>Productivity (2.5MRad), kg/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILU-8</td>
<td>0.6-1</td>
<td>20</td>
<td>200-600</td>
</tr>
<tr>
<td>ILU-6</td>
<td>1.7-2.5</td>
<td>20</td>
<td>500-1500</td>
</tr>
<tr>
<td>ILU-10</td>
<td>4-5</td>
<td>50</td>
<td>1300-3500</td>
</tr>
<tr>
<td>ILU-14 (project)</td>
<td>7.5-10</td>
<td>100</td>
<td>2500-7000</td>
</tr>
</tbody>
</table>
ILU-10 ACCELERATOR

- 1 - vacuum tank
- 2 - resonator
- 3 – magnet lens
- 4 – high vacuum pumps
- 5 - electron gun
- 6 – beam scanning system
- 7 - support
- 8 - separating vacuum capacitor
- 9 - HF autogenerators
Basic ILU Accelerators Dimensions

УСКОРИТЕЛЬ ИЛУ-8 В МЕСТОЙ ЗАЩИТЕ

УСКОРИТЕЛЬ ИЛУ-10

УСКОРИТЕЛЬ ИЛУ-6
PULSE MODULATOR
ILU-14 Accelerator

- 1 - electron gun
- 2 – accelerator cavity
- 3 – phase turner
- 4 – feedback feeder
- 5 - autogenerator
- 6 – power feeder
Accelerating structure ILU-14
ILU-14 Accelerator
Diagram of ILU-14 structure
Abbreviation: 50Гц – Synchronization pulse of 50Hz power line, 
Г – “GENERATOR” pulse, 
Н – “STORAGE” pulse, 
З – “CHARGE” pulse, 
P – “DISCHARGE” pulse, 
Π – “RECHARGE” pulse.
Time diagram of 3 modulator control pulses

Modulator
Control Unite (MCU)
MCU Program Diagram

- 4 independent timers to each MCU.
- +/- 2 mcs to each pulse accuracy.
- Working of 3 MCU together possibility
- Shift of first modulator is 6.6 ms to avoid double discharge pulse.
- Three MCU on RS-485 line.
- Jumper choice of MCU number.
- Frequency of accelerator pulses is controlled by first MCU.
- BUR pulse (scanner system).
- Any MCU to any modulator.
- All parameters is loading automatically.
Control Program of 3 MCU System

- MODULATOR-1
  Control Variables

- MODULATOR-2
  Control Variables

- MODULATOR-3
  Control Variables
SIMPLIFIED BLOCK DIAGRAM OF THREE MODULATOR CONTROL SYSTEM CONNECTION

- **MCU-1**
  - 50Hz
  - MCU REBOOT
  - INVERSE V
  - STORAGE OFF
- **MCU-2**
  - GENERATOR
  - STORAGE OFF
  - MCU REBOOT
  - INVERSE V
  - STORAGE OFF
- **MCU-3**
  - GENERATOR
  - STORAGE OFF
  - MCU REBOOT
  - INVERSE V
- **UPU-1**
  - RECTIFIER OFF
  - MODULATOR OFF
  - MODULATOR ON
- **UPU-2**
  - RECTIFIER OFF
  - MODULATOR OFF
  - MODULATOR ON
- **UPU-3**
  - RECTIFIER OFF
  - MODULATOR OFF
  - MODULATOR ON
- **MODULATORS**
  - OR-1
  - OR-2
  - OR-3

Connections:
- 4 MAIN IMPULSES + SCANNING PULSE
KEY FEATURES OF MODULATORS JOINING

- Adjusting of each pulse time place (+/- 2-200 mcs, accuracy +/- 2mcs)
- First time cycle and full cycle is 40 ms.
- All together rectifiers off.
- Storage off by first MCU.
- Storage off from any UPU to any MCU.
- Switch on/off all modulators together.
- Three pulses attached with 50Hz line.
- Shift of third modulator is 4.6 ms.
- Maximum time of charged modulator waiting is 17.4 ms.
- Pulse of the accelerator is placed in time when next storage process have started.
- Charge is off by inverse voltage protect.
- Rectifier is off by rectifier tiristors current stop.
- MCU rebut protect.
- Protection of anode overvoltage (UPUS).
Conclusion

- ILU-14 accelerator has finished preliminary tests and achieved pulse parameters.
- Storage shift conception has proved.
- 3 modulator control system was tested.
Thank you for your attention !!!