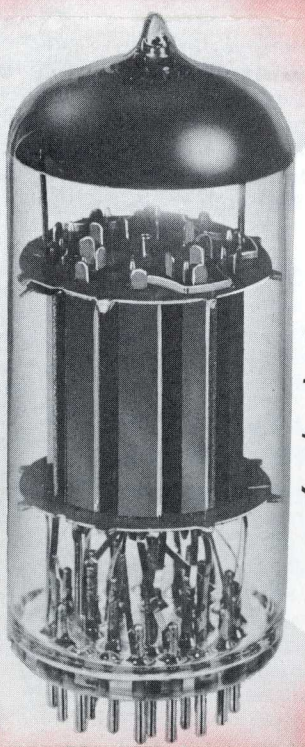
Burroughs

THIS IS WHY

*Beam-X** SWITCH



• SIZE —
1.1″ x 3″

• LOWEST COST

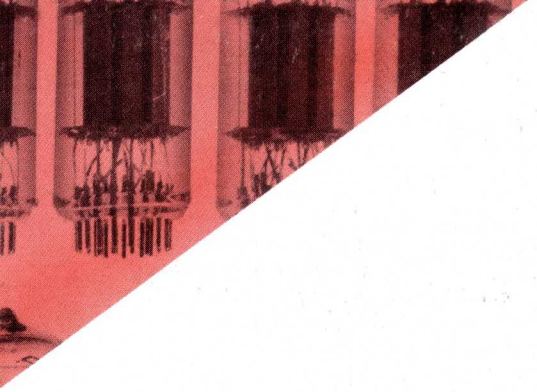
• WEIGHT —
1.8 OUNCES

• ELIMINATES 90 TRANSISTORS, DIODES AND RESISTORS

• RUGGED SHOCK AND VIBRATION

FIRST OF A FAMILY
MULTIPOSITION SWITCHES

BEAM-X APPLICATIONS • COUNTING • CODING • DISTRIBUTION • CONVERTING • MULTIPLEXING • SWITCHING • TIMING
• SAMPLING • PRESETTING • MATRIXING • DECODING • DIVIDING • GATING • MEMORY • OSCILLATING

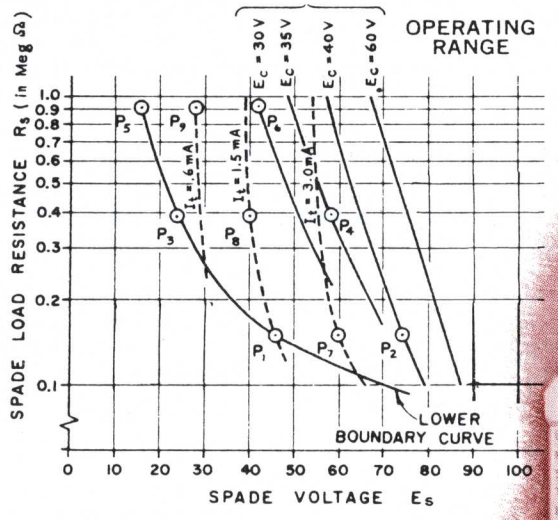


OUTPERFORMS ALL ELECTRONIC SWITCHES

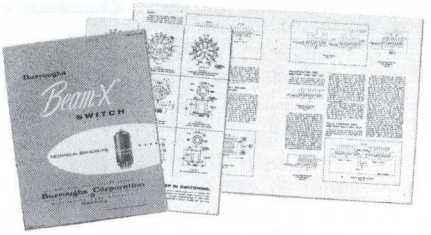
and

- 10 CONSTANT CURRENT OUTPUTS
- MEMORY AND AUTOMATIC LOCKING
- TOTAL POWER — 1.2 WATTS
- HIGH TEMPERATURE
- LONG LIFE
- SPEEDS FROM DC TO 10 MEGACYCLES
- ANY NUMBER OF POSITIONS
- OPERATING VOLTAGE FROM 12 V TO 200 V
- PRESETTABLE TO ANY POSITION
- OPERATES NIXIE® TUBES AND PRINTERS
- IMMEDIATE DELIVERY

and



BX-1000 IMPROVED CHARACTERISTICS



Detailed theory, circuit design and application data contained in Brochure BX-535 . . . Write for your copy today.

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ANOTHER ELECTRONIC CONTRIBUTION BY

Burroughs Corporation

ELECTRONIC TUBE DIVISION

Plainfield, New Jersey

*Beam-X** SWITCH
BX 1000

The BEAM-X switch, type BX-1000, is a 10 position, high vacuum electronic switching tube. It is intended for use wherever multiposition electronic counting, distributing or switching is required.

Introduction

The BEAM-X switch, type BX 1000, introduces for the first time a multi-position electronic switching device with a four-electrode structure per position. Whereas earlier Beam Switching Tube designs consisted of a triad in each position, the commercially available BEAM-X switch, type BX 1000, introduces a fourth electrode called the shield grid which results in greatly improved switching and output characteristics. The shield grid contributes three new functional characteristics by isolating the input switching requirements from the target output levels. First, it provides nearly "straight-line" switching characteristics; second, for constant switching grid input amplitudes, it permits target operation over a wide range of target voltages never before possible; and third, it allows for the operation of devices having non-linear characteristics, time-wise, such as gas discharge tubes, relays and pulse transformers.

Thus, in all respects users will find that the new four-electrode BEAM-X switch, type BX 1000, greatly simplifies their switching requirements, improves their circuit design and adds to their over-all performance and reliability.

DESCRIPTION OF SHIELD GRID

The shield grid is an entirely new electrode that is being introduced to Beam Switching Tube design. This electrode is physically located between the target and switching grid in such a manner as to provide almost complete isolation between these electrodes. Reference to Figure 6 will show that the electrode is L-shaped and essentially closes the end of the box that is provided for beam collection.

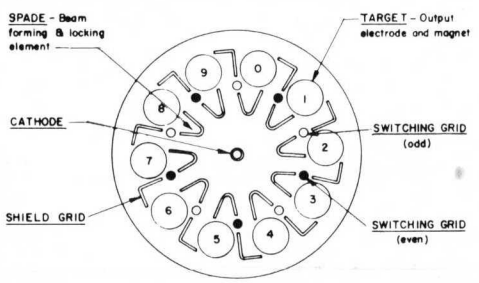

Fig. 6
CROSS SECTION

In the type BX 1000 BEAM-X switch all ten shield grids are internally tied together and brought out to a common connection at pin 11. Thus, in this particular type of BEAM-X switch, all of the shield grids are operated at a common potential and it is not anticipated that any output will normally be derived from them. The prime function of the electrode is to secure independence of the target and grid. In normal operation the shield grids are connected to the spade buss and draw only negligible current.

INDEPENDENCE OF TARGET CHARACTERISTICS

The significance of the shield grid may be seen by reference to Figure 7. In Beam Switching Tubes, the stability of the tube depended to a considerable extent upon the level of target voltage. At low target voltages (voltages below the knee of the target characteristic curve) the tube tended toward instability because the constant current was not being collected by the target and was leaking to other elements.

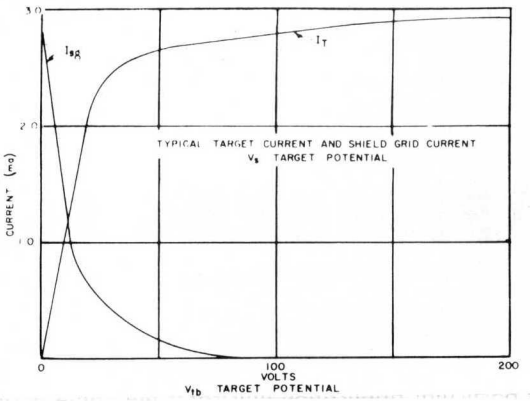

Fig 7
TYPICAL TARGET CURRENT AND SHIELD GRID CURRENT VS TARGET POTENTIAL

Figure 7 illustrates how this leakage current is collected by the shield grid as the target falls below the knee of its characteristic curve. It is this function of the shield grid that provides the independence of target characteristics. Previously, operation below the knee of the target pentode characteristic was impossible; however, with the addition of the shield grid, operation with target potentials as low as zero volts is possible with only a slight limitation in the operating range of the tube.

STRAIGHT-LINE SWITCHING CHARACTERISTICS

Improved switching characteristics are closely associated with the improved target characteristics. In Beam Switching Tube types, the switching grid amplitude required was dependent to a large extent upon the potential of the target. This meant that as the target voltage was increased, a larger switching grid input amplitude was required to effect proper switching action. This resulted from the reduction of beam current for switching because of the tighter beam formation associated with high target potentials. Conversely, as the target potential was lowered, the

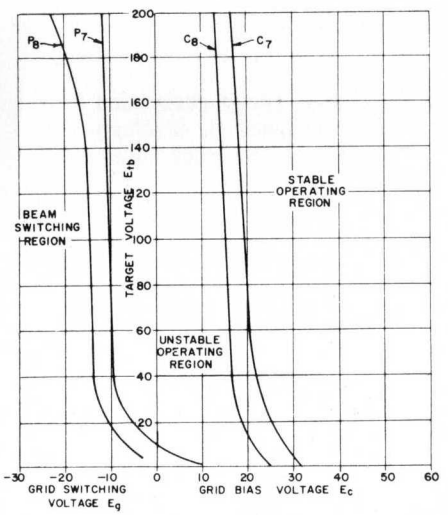

Fig. 8
TYPICAL TARGET VOLTAGE VS SWITCHING GRID CHARACTERISTICS

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leakage currents increased and less switching grid input amplitude was required to effect switching. In the extreme, when the target potential has been lowered below the knee of its characteristic curve, instability of the beam resulted because of excessive leakage. At higher frequencies of operation increased drive was often required because the RC time constants associated with the target were comparable in magnitude or larger than the period of the input wave form. Thus, the target potential remained high and switching was relatively more difficult.

The shield grid effectively isolates the switching grid from the effects of the target potential, as the curves of Figure 8 indicate. Thus, the input requirements remain virtually constant over the allowable target voltage range. This characteristic means that switching at high frequencies where large outputs are required is now relatively simple to achieve.

NIXIE® OPERATION

One of the major uses of the type BX 1000 BEAM-X switch is in connection with NIXIE indicator tubes. This particular application illustrates the value derived from the introduction of the fourth electrode. In the normal operation of NIXIE tubes from a BEAM-X switch, high target potentials are required to insure proper ionization of the NIXIE tube; e. g., types 6844A and B5031 NIXIE tubes require 170 volts. Thus, in high speed circuits we have a situation wherein the straight-line switching characteristics are of great value in permitting switching to continue normally even though the targets are varying at a high potential. A further complication which may arise in connection with the use of NIXIE tubes, occurs during the time required for the gas to ionize. During this time interval (2-5 microseconds) the NIXIE tube represents an extremely high impedance. Thus, there is a strong tendency for the targets to "bottom " (drop to cathode potential). Were it not for the shield grid, this "bottoming" would result in excessive leakage to the switching grid and leading spade and cause switching instability. However, as can be noted from Figure 7, during this short time interval when the target is "bottomed," the shield grid effectively absorbs the excess leakage current and prevents this instability from occuring.

This new characteristic of the BEAM-X switch is equally useful in the operation of all non-linear devices, such as gas discharge tubes, relays and pulse transformers.

Thus:

In the new type BX 1000 BEAM-X switch, the circuit designer has available a device giving unparalleled freedom from interaction and coupling between input and output. With this newly gained design freedom . . . switching, counting and distributing applications will be simpler to perform and many new and exciting developments will be made possible.

These application notes should be used in conjunction with Technical Brochure BX535 which describes basic BEAM-X switch characteristics in greater detail.

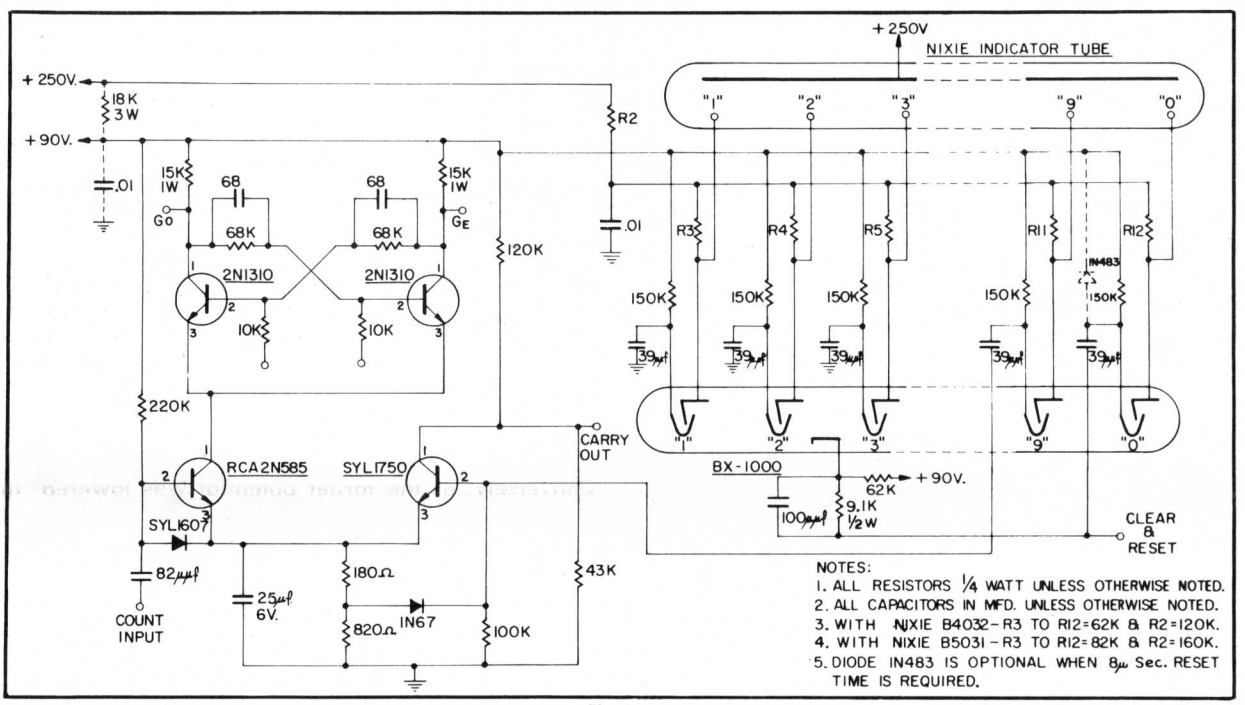

Fig. 9
TYPICAL 110 KC BEAM-X COUNTER
TRANSISTOR DRIVER WITH NIXIE TUBE OUTPUT

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